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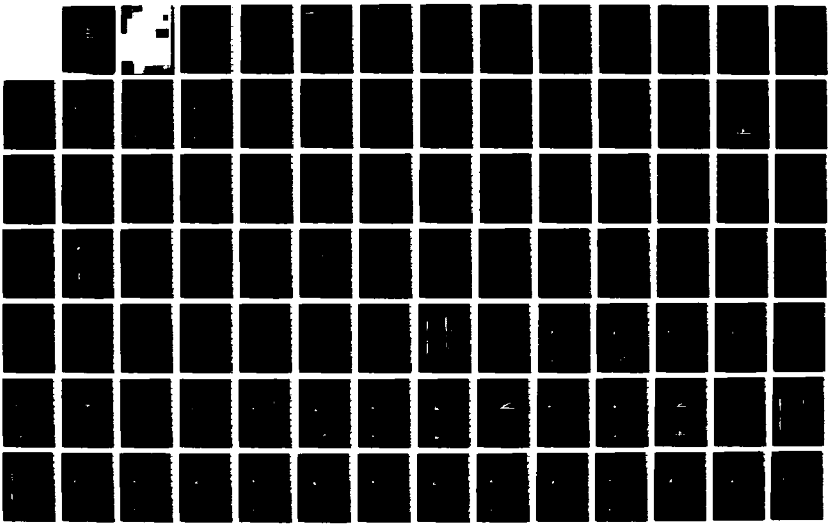

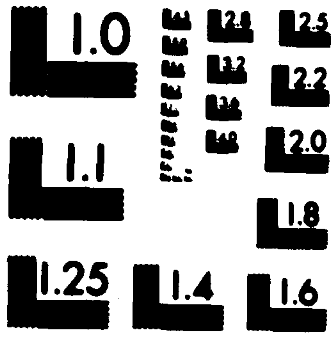

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TECHNICAL REPORT ITL-87-3

EVALUATION OF THE P-LEVEL FINITE-ELEMENT PROGRAM "FIESTA"

by

Robert L. Hall, Chris A. Merrill

Information Technology Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
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This study examines the P-level finite-element program "FIESTA" from an unbiased position. The purpose of such an examination is to determine whether or not the program should be included in the Corps of Engineers' file of finite-element programs. This evaluation further verifies the accuracy, cost effectiveness, and user friendliness of FIESTA by implementing it to analyze several general structural problems of Corps interest.

The evaluation of FIESTA is accomplished by analyzing a two-dimensional cross section of a concrete dam; plate problems with varying thickness to depth ratios under surface, gravity, and temperature loading; examination of proper aspect ratio of elements; and a three-dimensional intermediate pier with unsymmetric loading of a concrete dam. The evaluation is based on a comparative study of FIESTA and GTSTRUDL codes (P-version and H-version, respectively).

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PREFACE

This report provides an evaluation of the finite-element code, FIESTA. Work on this evaluation was done by the Engineering Applications Group (EAG), Automation Technology Center (ATC), US Army Engineer Waterways Experiment Station (WES), in support of the Computer-Aided Structural Design (CASD) Committee of the US Army Engineer Division, Lower Mississippi Valley (LMVD), and the US Army Engineer District, St. Louis (LMS). After a reorganization, EAG is presently the Engineering Applications Office. Funds were provided by LMVD and LMS as part of WES ATC engineering analysis support.

Mr. V. M. Agostinelli of LMVD was chairman of the CASD Committee during this work. Dr. Robert L. Hall, formerly of EAG and presently with the WES Structures Laboratory, and Mr. Chris A. Merrill, PE, performed the work and wrote this report. Messrs. Tom Mudd and John Jaeger of LMS, V. M. Agostinelli, Joe Baudrexel, MCAUTO, and Dr. B. A. Szabo, Washington University, provided assistance and reviewed various stages of this report. The work was performed under the direction of Mr. Paul K. Senter, Chief, Scientific and Engineering Applications Division, ATC, and presently Acting Chief, Information Research Division, Information Technology Center (ITL), with overall supervision by Dr. N. Radhakrishnan, Chief, ATC, and presently Acting Chief, ITL. Mses. Gilda Miller, Frances Williams, and Deborah Shiers, Editor and Editorial Assistants, respectively, Information Products Division, ITL, WES, provided final editing of the material for this report before publication.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
degrees (Fahrenheit)	5/9	Celsius degrees or Kelvins*
feet	0.3048	metres
inches	2.54	centimetres
kips (force)	4.448222	kilonewtons
kips (force) per square foot	47.88026	kilopascals
pounds (force)	4.448222	newtons
pounds (force) per cubic foot	16.01846	kilograms per cubic metre
pounds (force) per foot	14.5939	newtons per metre
pounds (force) per square foot	47.88026	pascals
pounds (force) per square inch	6.894757	kilopascals
square inches	6.4516	square centimetre

* To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.15$.

EVALUATION OF THE P-LEVEL FINITE-ELEMENT PROGRAM "FIESTA"

PART I: INTRODUCTION

Objective

1. The objective of this study is to evaluate the finite-element (FE) program FIESTA. Preliminary studies completed by the St. Louis District indicated that FIESTA is a viable three-dimensional (3-D) linearly elastic FE program that yields accurate and cost-effective results. This study further verifies the accuracy, cost effectiveness, and user friendliness of FIESTA by using the program to analyze several general structural problems of interest to the US Army Corps of Engineers (USACE). For a basis of comparison, the general purpose FE code, GTSTRUDL, can be used to solve all the example problems. The Corps of Engineers has used many different FE programs (Radhakrishnan 1979, Hall and Radhakrishnan 1984), and this study examines FIESTA from an unbiased position to determine whether or not FIESTA should be included in the Corps of Engineers' arsenal of FE programs.

Scope

2. The evaluation of FIESTA can be determined in accordance with the success of the program with the following cases:

1. A two-dimensional (2-D) cross section of a concrete dam (plane-strain problem).
2. Plate problems with varying thickness to depth ratios under surface, gravity, and temperature loading.
3. Examination of proper aspect ratios of elements.
4. A 3-D intermediate pier with unsymmetric loading of a concrete dam.

3. The solution of each problem involves a mesh convergence study. The developers of FIESTA have published several articles (Babuska and Szabo 1980, Szabo and Babuska 1982a and 1982b) indicating that with multiple solutions any functional value, such as energy or a stress component, can be used to produce a convergence plot, and that this data can be extrapolated to determine the

theoretical solution. This information can then be used to determine the degrees of freedom (DoF) required to obtain the desired accuracy. This study produced a plot of a stress component versus DoF with results from the P-version FE program, FIESTA, and the H-version FE program, GTSTRUDL. In addition, plots of cost versus DoF were also produced.

Two-Dimensional Studies

4. The solution of the 2-D cross section of a concrete dam is not an appropriate evaluation problem for FIESTA, a 3-D program. However, since 2-D problems can be appropriate for initial studies, FIESTA must be capable of solving these simple problems in a cost-effective way to be considered an effective design tool for the Corps of Engineers. This problem also provides for the use of simple grids which are easily produced for either of these FE codes.

Plate Problems

5. The plate problems with varying span (L)* to thickness (t) ratios provide a different class of problems for an accuracy study. Plates are classified as follows:

$1/40 < t/L < 1/20$ = thin plate

$1/20 < t/L < 1/10$ = moderately thick plate

$t/L > 1/10$ = thick plate

6. The thin plates with behavior according to thin plate theory (Timoshenko and Woinowsky-Krieger 1959) have no shear deformation and can be modeled with the PBHQ or IPBQQ elements, for the GTSTRUDL runs. The IPBQQ element was used for the thin plate GTSTRUDL Studies. The moderately thick plate does have shear deformations. Reissner (Salenno and Goldberg 1960 and Carley and Longhear 1968) presented theoretical solutions for plates with shear deformations. The GTSTRUDL, IPBQQ based on Reissner's theory, was used to model the moderately thick plate. The thick plate was modeled with an eight-node brick element for the GTSTRUDL runs. The FIESTA program used hexahedron elements for all plates.

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* For convenience, symbols and abbreviations are listed in the Notation (Appendix I).

Aspect Ratio

7. The examination of proper aspect ratios was made only for FIESTA. The problem of aspect ratios greater than four for the H-version FE is presently shown by Desai and Abel (1972) and this uses their example to evaluate the aspect ratios of FIESTA. The goal of the study is to determine at what point in the increasing of the aspect ratio will FIESTA no longer produce usable results.

Three-Dimensional Pier

8. The comparison of FIESTA versus GTSTRUDL for the 3-D intermediate pier with unsymmetric loading should demonstrate the strength of FIESTA. Since FIESTA was first designed for the modeling of large concrete dams, this comparison should allow the demonstration on how the program can model a large problem with fewer elements. The use of models with a fewer number of elements is always advantageous. Just as closed-form solutions are always preferable over any numerical solution, the grids with FE's allow for easier building and checking of the model.

P-Version/H-Version Finite-Element Codes

9. This study will refer to the FIESTA code as a P-version FE code and will refer to the code GTSTRUDL as an H-version. This labeling of codes is consistent with the published literature for the FIESTA code. Since the FE selection is an approximate solution, each FE problem must be solved more than once to check for convergence. FE codes which have elements developed from a strict stiffness formation will always have displacement results which are too stiff. However, as the DoF increase, the displacements will approach a constant value. The convergence for the H-version code is obtained by making the element smaller (height smaller, i.e., H-version) while the P-version code, the order of the assumed polynomial (i.e., P-version) representing the displacement function, is increased.

PART II: TWO-DIMENSIONAL CROSS SECTION OF CONCRETE DAM

Objective

10. This phase of the study was the initial examination of the P-level FE program FIESTA. The problem used for this initial study was a cross section of the nonoverflow of the R. B. Russell concrete dam (Figure 1*). This provides a typical problem for which the FE method would be used. The cross section was used to examine mesh convergence, execution, cost, and output.

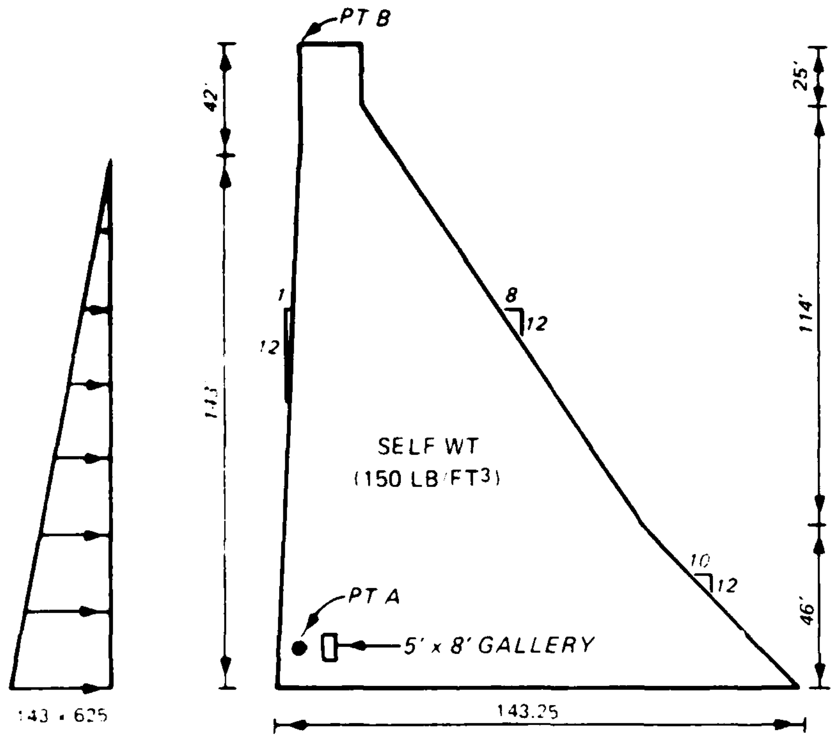

Figure 1. Geometry of the R. B. Russell nonoverflow section and loads

11. As stated previously, this is not a problem that provides a good comparison between FIESTA and a typical FE program using 2-D elements, since FIESTA is a 3-D program. However, the mesh-convergence study provided insight

* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 4.

on size and shape of elements needed for convergence, cost of execution, output tables and plots.

FIESTA Grids

12. The first FIESTA grid (Figure 2) was constructed with as few elements as possible with the gallery in the dam dictating the shape of this grid. If the gallery were not present, a smooth simple grid could have been generated. The commands for generating the geometry, loads, plots, and executing data are given in Appendix A.

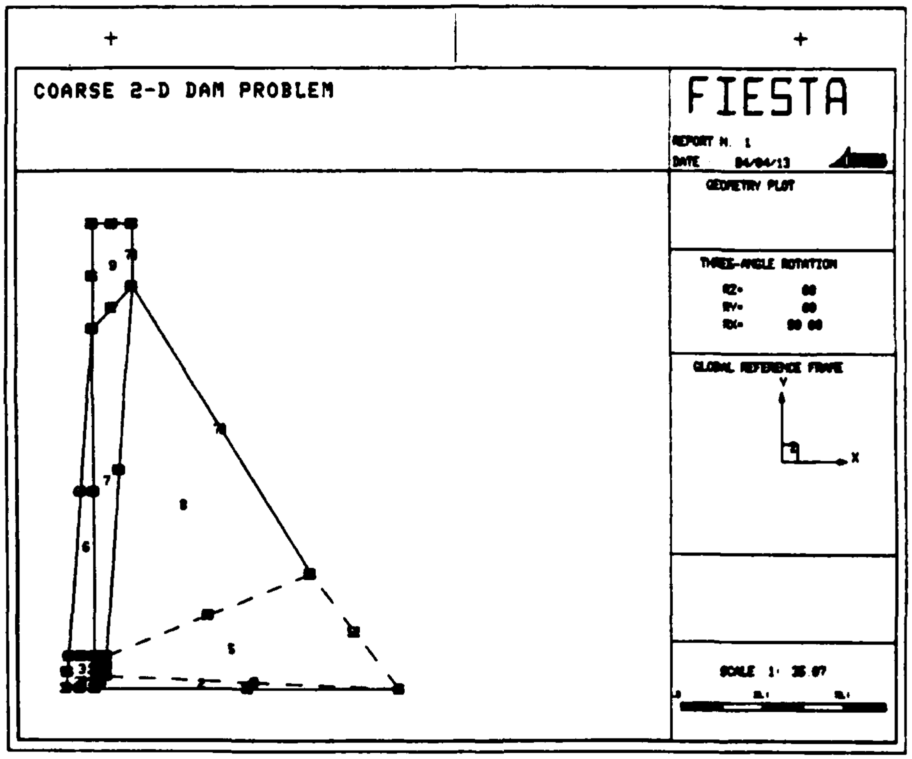

Figure 2. Coarse 2-D dam

13. The contour plots for the stresses in the X and Y directions are shown in Figures 3 and 4. These plots illustrate that the coarse grid provides poor results. The contours are very erratic at element boundaries, and thus produce results which are not suitable. This illustrates the fact that the users of FIESTA must construct reasonable models to obtain reasonable results.

14. This fact is true regardless of which FE code is used. However,

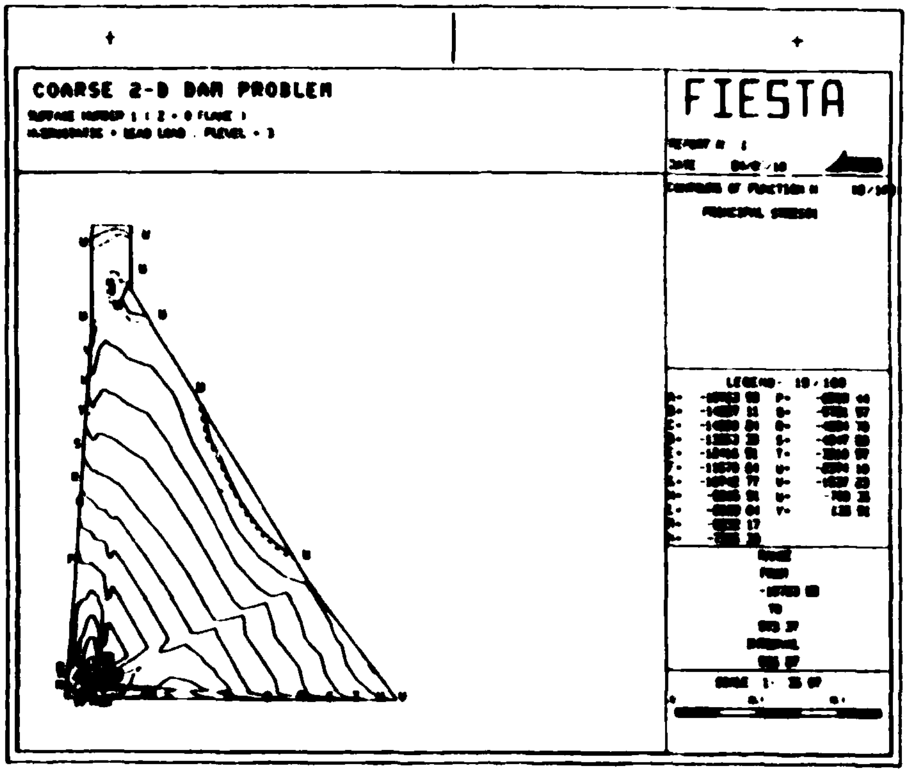

Figure 3. Sigma XX stresses

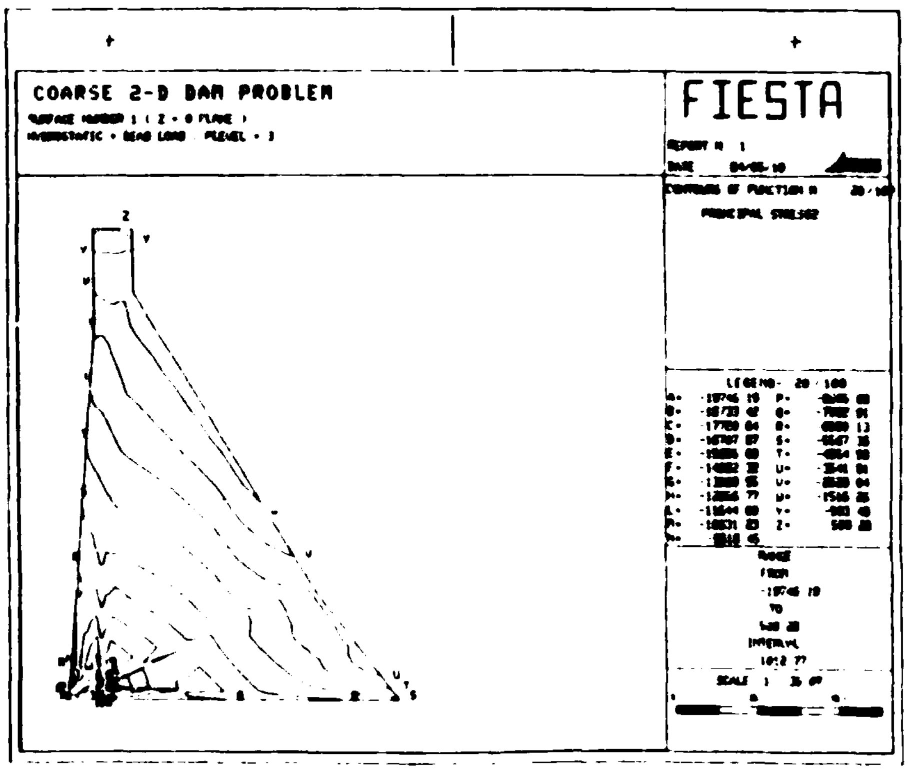

Figure 4. Sigma XY stresses

the coarse model does indicate that FIESTA is also sensitive to model configuration. If the gallery had been omitted, FIESTA could have modeled this cross section with only a few elements, many fewer than required by the typical H-version FE codes. Thus, this grid illustrates that changes in geometry of the structure will dictate how FIESTA is used in the grid.

Fine FIESTA grid

15. Figure 5 displays a FIESTA grid with 29 elements. This grid produced results which appear to be corrected. Figures 6 and 7 display the contours of the stresses in the X and Y direction for P-level 3. The model and commands needed to produce these results and contour plots for P-levels 1 and 2 are given in Appendix B.

Mesh convergence for FIESTA

16. Table 1 gives the results for the coarse grid. The points A and B given in Tables 1 and 2 are shown in Figure 1. Although the contour plots given in Figures 3 and 4 are poor, the vertical displacement for point B using a P-level of six has a 3.6 percent difference for point B of the fine grid using a P-level of five. The other displacement for the coarse grid compares

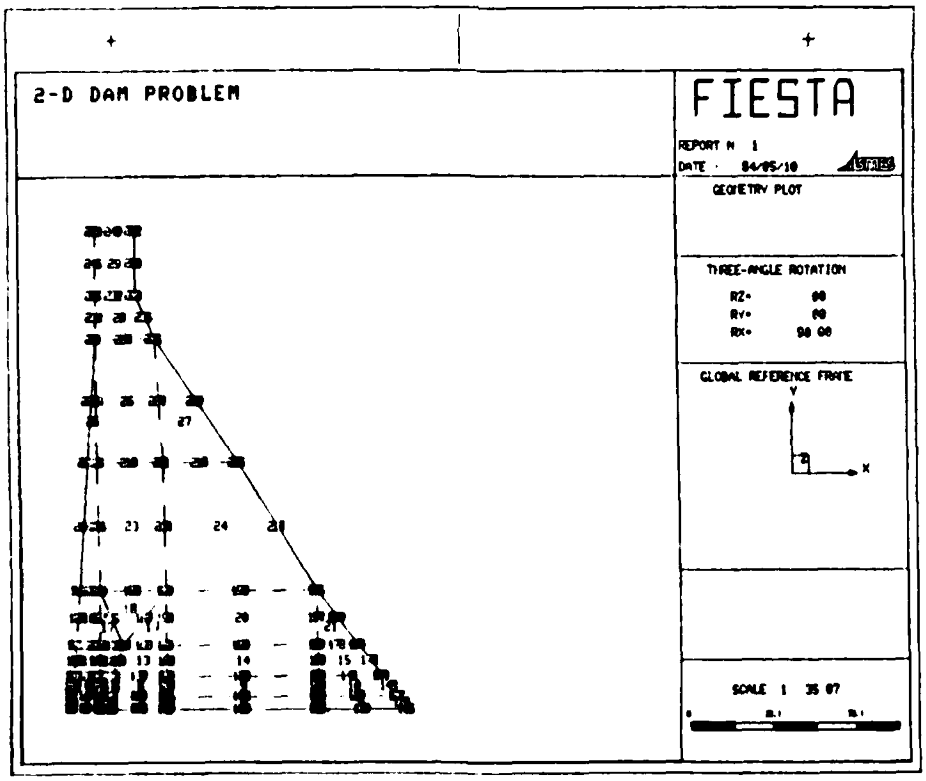

Figure 5. Fine grid

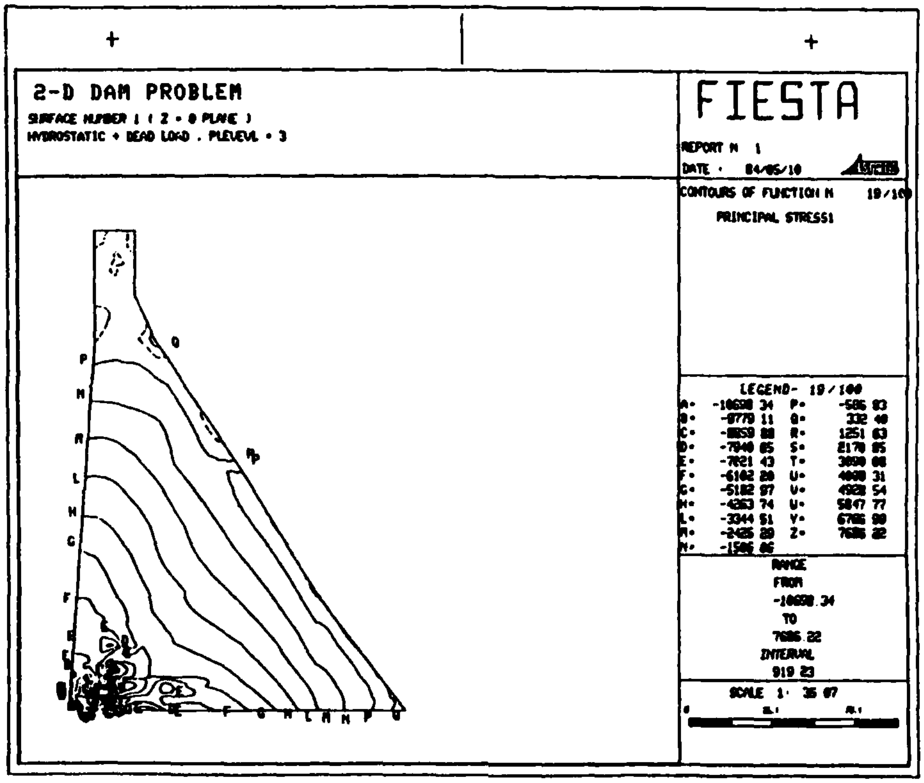

Figure 6. Sigma XX stresses

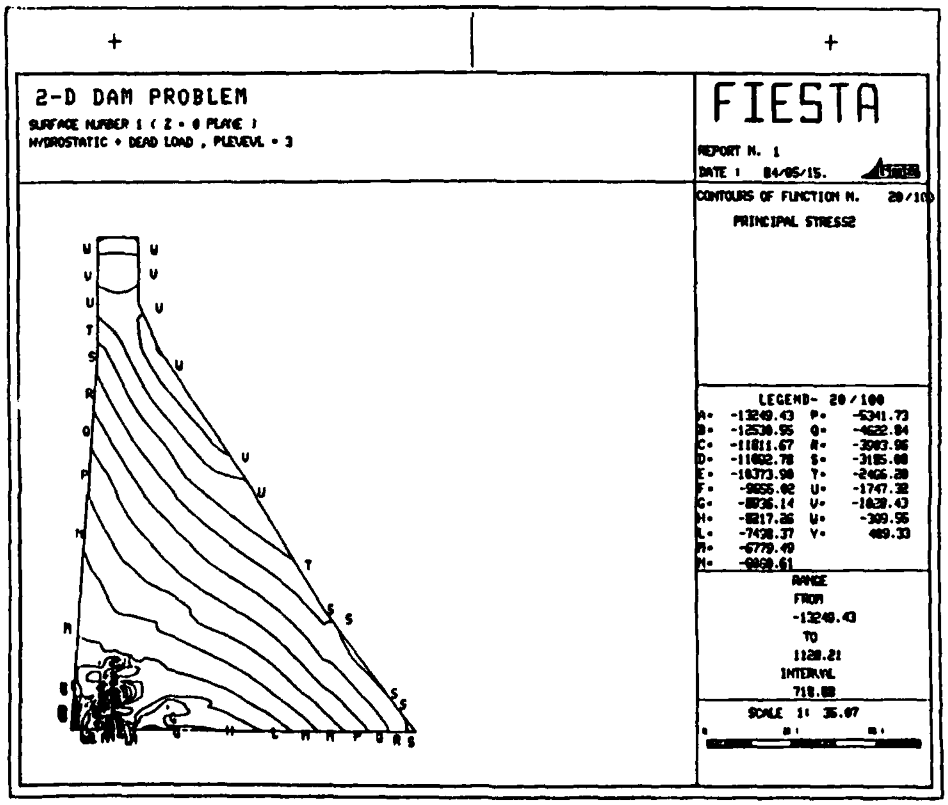

Figure 7. Sigma YY stresses

Table 1

2-D Dam Coarse Mesh

DoF	P-Level	Y-Displacement at Point A	Y-Displacement at Point B	Potential Energy	Cost $
40	1	-0.23501 E-3	-0.24088 E-2	-0.127339685455E4	11.53
150	2	-0.29606 E-3	-0.31899 E-2	-0.141805592838E4	13.59
246	3	-0.29618 E-3	-0.33370 E-2	-0.142440390321E4	16.78
658	6	-0.29361 E-3	-0.33370 E-2	-0.143644746618E4	52.99

Table 2

2-D Dam Fine Mesh

DoF	P-Level	Y-Displacement at Point A	Y-Displacement at Point B	Potential Energy	Cost $
128	1	-0.27156 E-3	-0.30447 E-2	-0.137289735799E4	24.08
468	2	-0.29382 E-3	-0.32983 E-2	-0.140854642986E4	30.87
763	3	-0.30045 E-3	-0.32987 E-2	-0.141114993286E4	40.85
1693	5	-0.30439 E-3	-0.33029 E-2	-0.141314757474E4	134.36

closely with the results given for the fine grid in Table 2. Since the results for the coarse grid are questionable, a detailed mesh convergence study will not be done for the coarse grid. However, all the results for the coarse grid appear to be near convergence, except for X displacement of point B.

17. Figure 8 displays the potential energy versus the inverse of the

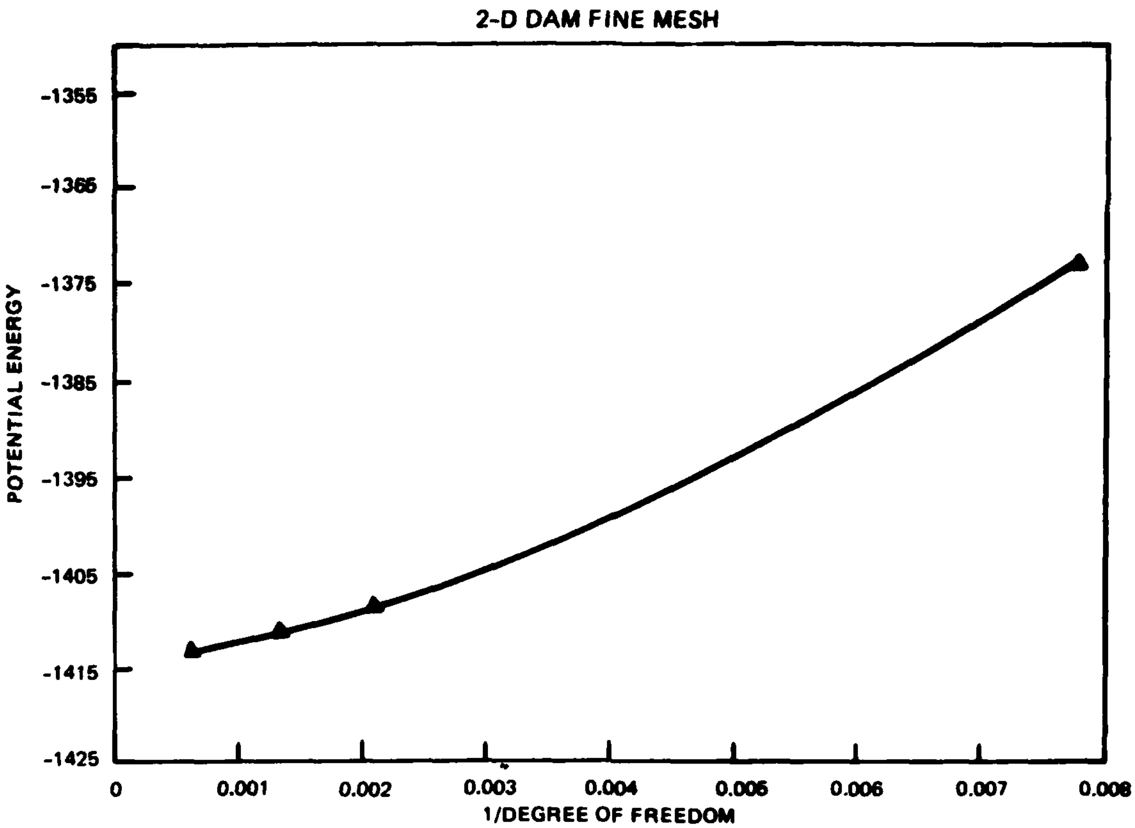

Figure 8. Plot of potential energy versus the inverse of DoF

DoF. This plot indicates that for an infinite DoF the potential energy would be approximately -1,415. The FIESTA Training Manual gives the following equation for calculating this value for any two FIESTA solutions:

$$U_o = \frac{N_2^{2\alpha} \; U_2 - N_1^{2\alpha} \; U_1}{N_1^{2\alpha} - N_1^{2\alpha}}$$

where

N = DoF

U_o = total potential energy

2 = solution from higher P-level

1 = solution from lower P-level

α = singularity parameter (0.5 to 1)

Everything in the equation is simple enough to determine except for the singularity parameter. The singularity parameter is problem dependent and can only be approximated for most problems. Using the values from Table 2 for P-levels 2 and 3 and assuming $\alpha = 0.5$, $U_o = -1,415.17$.

18. These results indicated that the potential energy for P-level 2 was 0.47 percent in error, P-level 3 was 0.29 percent, and P-level 5 was 0.14 percent in error. However, these results did not give the percentage of error in displacements or stresses, but gave an indication of reliability of solution. If the Y displacement for P-level 5 at point B was assumed to be correct, the corresponding Y displacements for P-levels 2 and 3 were in error by 0.32 and 0.13 percent, respectively.

19. These results indicate that the fine mesh had more elements than necessary for this problem. This was obvious since the potential energy and displacement have converged for P-level 3. This was basing convergence on what is typically being done for H-version FE analysis. Typically, a grid is said to have converged when additional DoF have "little change" to results at the point of interest and the magnitude of "little change" is left to the discretion of the designer/analysis.

20. However, if fewer elements had been used, the slope of the line in Figure 8 would have been greater. The engineer must then determine how many DoF are necessary to obtain good results. This can be accomplished by calculating a value for the potential energy at an infinite DoF as was done for the fine mesh. This calculation should never be done using P-level 1 results. The P-level 1 solution is good only for an initial run to determine if input data appear to be correct. The larger errors in the P-level 1 solution can be seen in Figures 6 and 7. The active DoF versus relative error in energy can then be plotted (FIESTA Training Manual 1983):

$$e = \left[\frac{U_o - U}{U_o}\right]$$

where

e = relative error in energy

U = potential energy for a particular P-level

From this point the user can determine approximately how many DoF will be necessary for a desired percentage error. It is possible that there is not a sufficient number of elements present in the model to produce the required DoF. If this is the case, a new model must be generated.

21. Figure 9 displays the Y displacements at point B versus the inverse of the DoF. This figure also shows that the problem has converged for P-level 3.

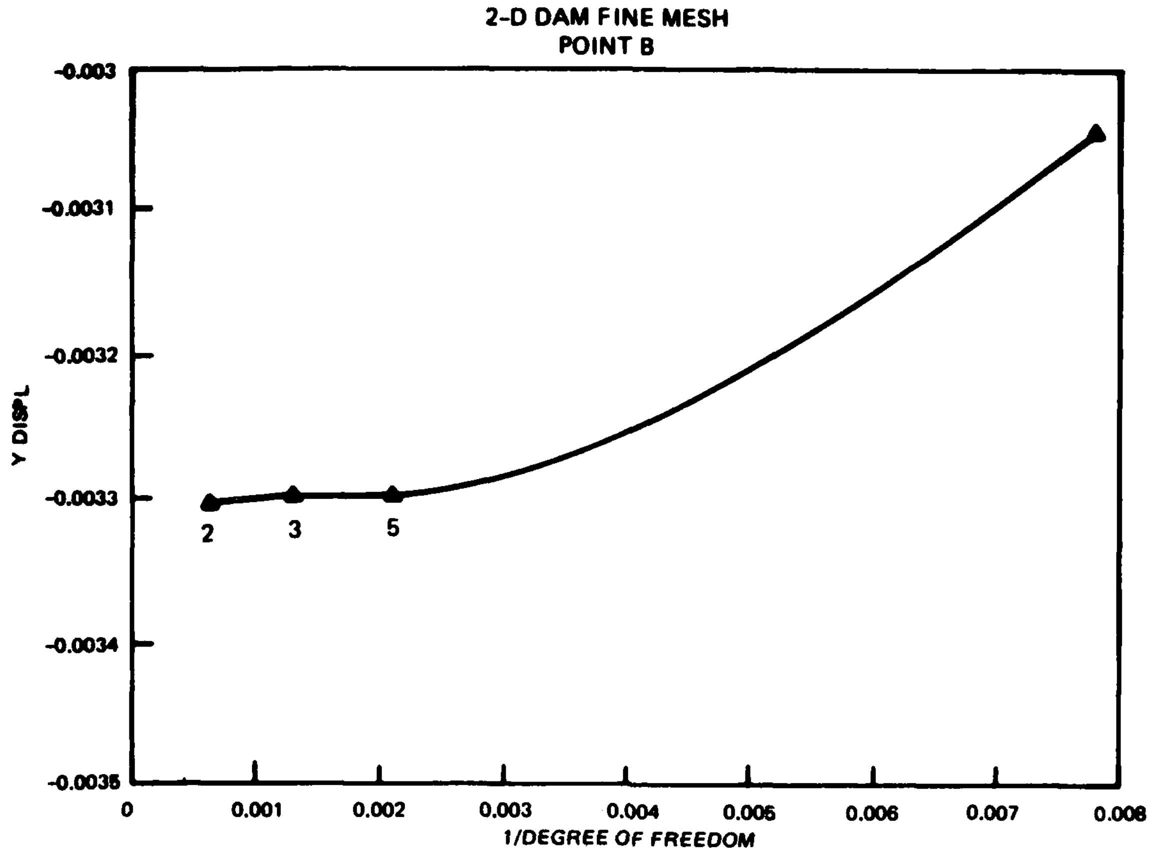

Figure 9. Vertical displacement at point B

GTSTRUDL Grids

22. Figures 10, 11, and 12 display the three grids for the GTSTRUDL models. These grids use the IPLQ element, the lowest level of an isoparametic element. This element uses an assumed linear displacement function. A typical H-version FE, it requires more elements than the higher order isoparametric elements. However, it does provide information of rate of convergence for an FE problem using an H-version code. Figures 13 and 14 display the stresses in the X and Y directions for the grid shown in Figure 12. Appendix C contains all the data files necessary to produce the results displayed.

Convergence of GTSTRUDL

23. Figure 15 plots the vertical displacement of point B versus the inverse of the DoF. The plots show the problem has converged, i.e., little change in displacement for increased DoF as Table 3 calculations show. However, this convergence study required the generation of different grids.

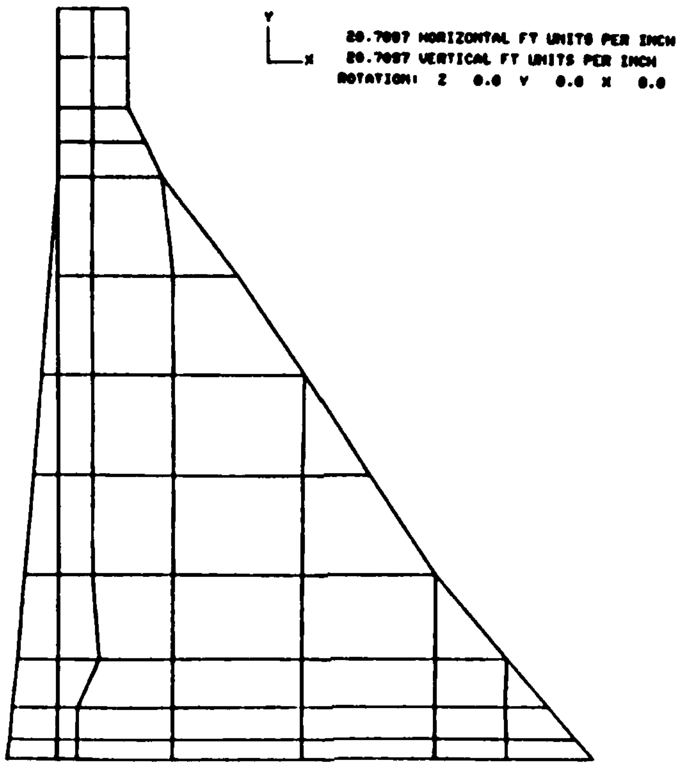

Figure 10. GTSTRUDL Model 1

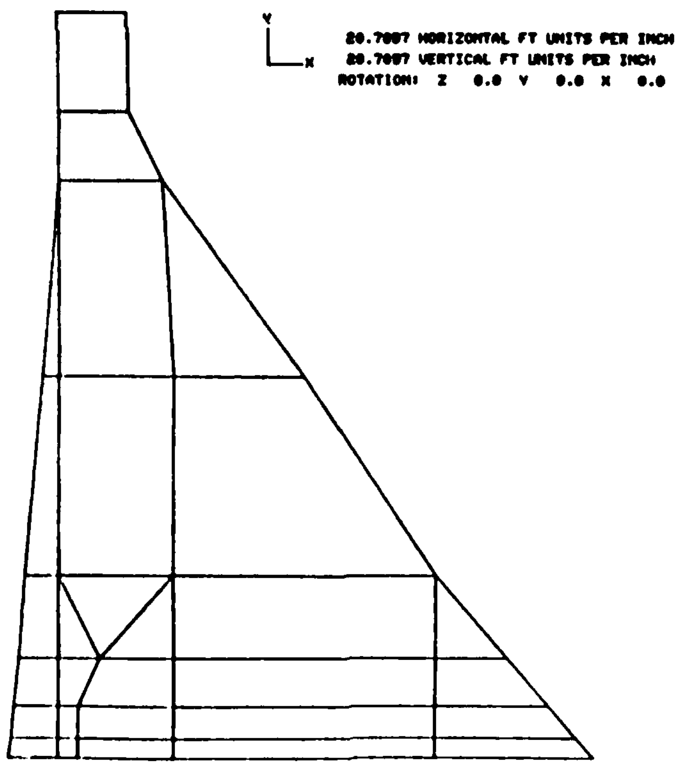

Figure 11. GTSTRUDL Model 2

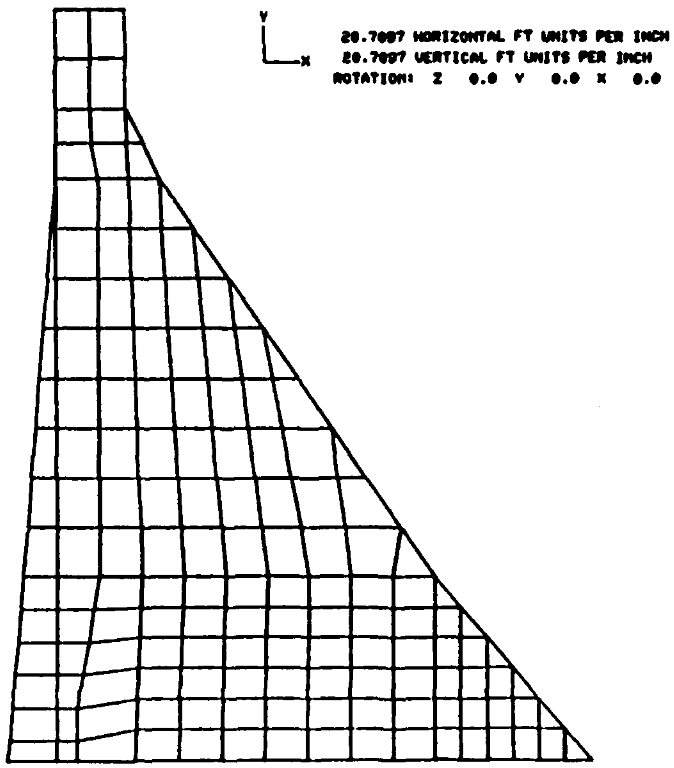

Figure 12. GTSTRUDL Model 3

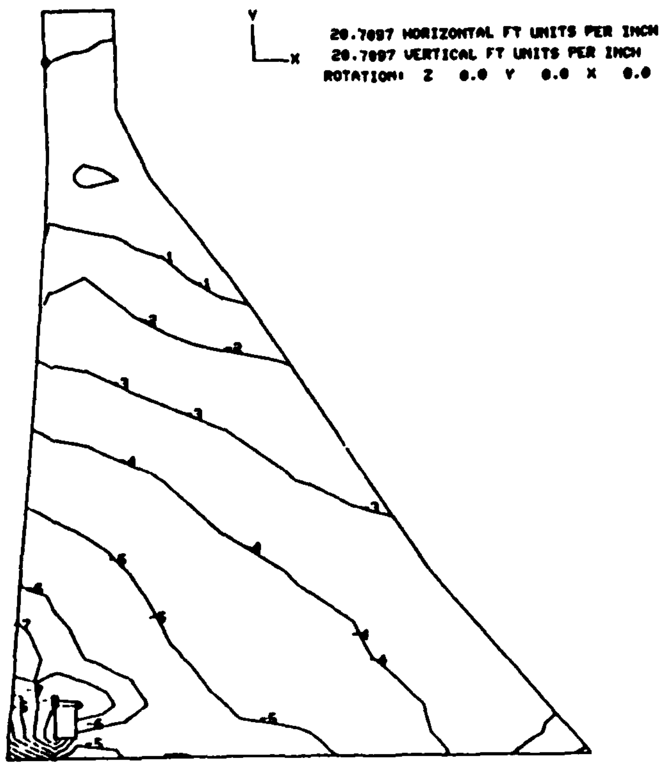

Figure 13. S_{XX} stresses

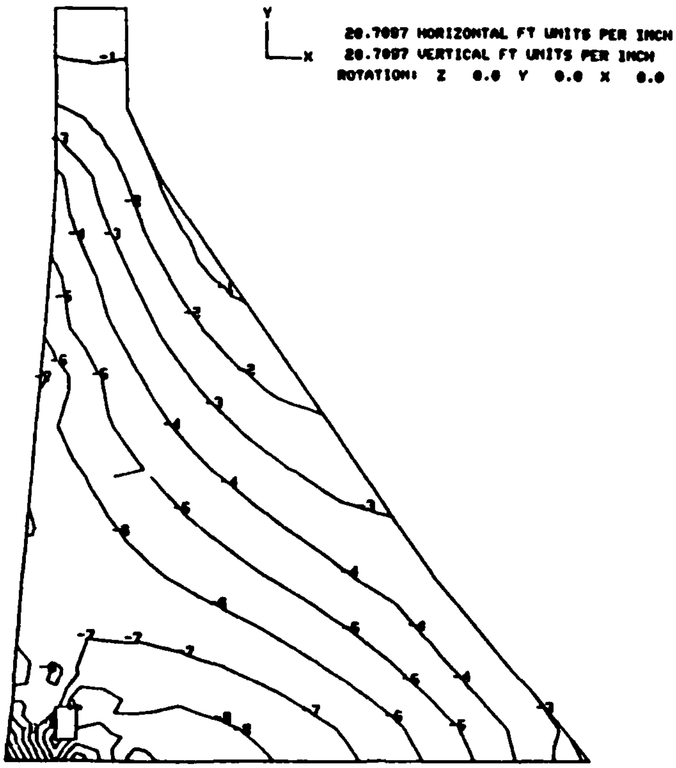

Figure 14. S_{YY} stresses

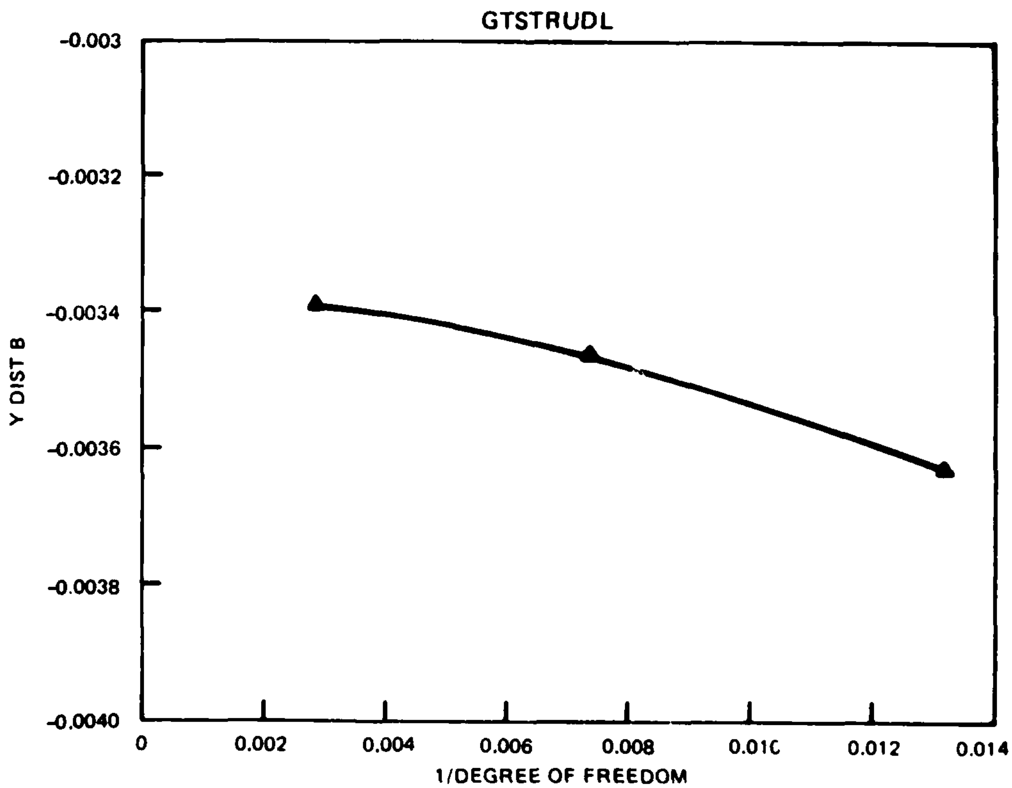

Figure 15. Y displacement at point B

Table 3

GTSTRUDL Runs

	DoF	Y-Displacement at point B	Cost Normal $ (Pu)	Cost Overnight $/(P2)
0.0132	76	-0.0036339	2.56	0.20
0.0074	136	-0.0034644	3.80	0.29
0.0020	348	-0.0033919	8.20	0.63

Comparison

24. As shown in Tables 2 and 3, the GTSTRUDL runs are not as expensive as the FIESTA runs. A major reason for difference in cost is the rates in the different computer systems on which FIESTA and GTSTRUDL exist. The GTSTRUDL problems were run on the Control Data Corporation computer which provides the Corps of Engineers with some of the cheapest computer resources available with sufficient computer power to execute programs such as GTSTRUDL. The FIESTA runs were made using the MCAUTO computer services. Another reason for the expense difference is that the FIESTA problems were 3-D, while those in GTSTRUDL were 2-D. FIESTA's surface loading functions, along with the ability to increase the DoF without generating a new grid, proved it superior to GTSTRUDL. Each program provides adequate documentation and simple entering of input data. The GTSTRUDL data files were more easily generated with the 2-D elements and a familiarity with GTSTRUDL.

Conclusions

25. FIESTA input data, as seen in the appendixes, can be constructed easily and presents few problems to the first-time user. The user also has the option to obtain output data at selected points and a variety of plots.

26. At the beginning of this study, errors were found in using the hydrostatic head data. The command allows the user to define the water-pressure data completely separate from the FE data. The problem was fixed in a reasonable time frame which indicates good support for FIESTA.

27. The features of being able to define surfaces are very beneficial. This feature aids in defining restraints, loads, and plotting and was used to apply restraints on both Z planes, allowing the solution of a plane-strain problem. Also, the surface definition was used in defining the hydrostatic loads to the concrete dam.

28. Only one other difficulty, window plotting of the contour data, was found during this study. As seen in Figure 16, when a window of a separate area is plotted, the character size is in constant relationship to the entire grid and not the specific area being displayed. The program has a command "CHECK" which instructs FIESTA to check topology of grid and distortion of errors. If topology or distortion errors are found, the program stops execution. Therefore, in the initial phase of developing a grid, the command for plotting the grid must be given before checking is done, or any checking by

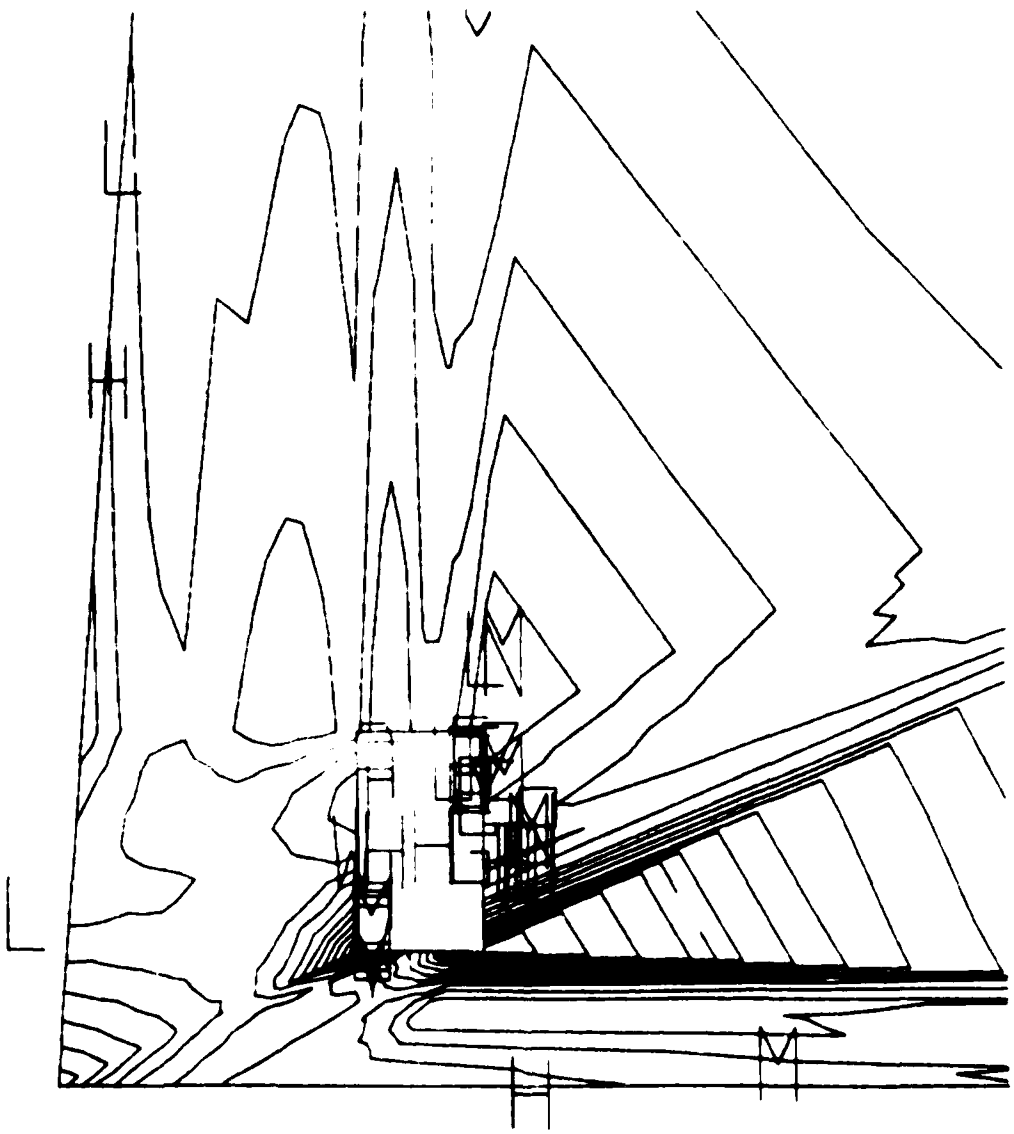

Figure 16. FIESTA window plot

the program must be eliminated until the grid appears correct. The checking routine will stop execution of any program with a distortion index of six. However, the example problem used in the FIESTA manual has a distortion index of 10. The problem was executed with the removal of the check command, giving good results at the point of interest due to the fact that the bad element was sufficiently away from the area of importance.

29. This study, using a 2-D cross section of concrete dam, illustrates that FIESTA can be used to solve 2-D problems. However, this does require the entry of more than necessary data and uses an application for solving a less complicated problem than the application was developed for. This study also shows that the results of FIESTA are dependent upon the mesh as well as the assumed P-level. This is typical of all FE codes and is not a deterrent for using FIESTA.

PART III: PLATES WITH VARIABLE THICKNESS

Objective

30. This phase of the study was to verify the accuracy, cost effectiveness, and user friendliness of FIESTA for plate-type structural problems. GTSTRUDL was used along with theoretical calculations for comparison with FIESTA.

Problem

31. Three 20- by 20-ft steel fixed plates were analyzed using FIESTA: (1) a thin plate criterion, $t/L = 1/40$* , (2) a moderately thick plate criteria, $t/L = 1/13.33$** , and (3) a thick plate criteria, $t/L = 1/4$† . P-levels 1 through 5 were used for each plate resulting in a total of 15 FIESTA analyses. The three plates were also modeled using GTSTRUDL (one model per plate). Each plate was subjected to the following load cases:

1. 100-psf uniform load
2. Dead load
3. Uniform temperature change of 50° F††

Modeling

32. Since the problem was doubly symmetrical, only one quarter of the problem was modeled.

FIESTA

33. A coarse grid, two rows of elements each way, was used for the three plates to check FIESTA's capabilities and claims. The use of fewer elements than H-version codes, the convergence prediction claims shown in the FIESTA Training Manual (1983), and the utilization of the codes' ease of nodal refinement capability were items checked by the grid. Symmetry was modeled by allowing nodes on the planes of symmetry to displace in the Z direction, while restraining X displacements along the Y plane and Y displacements along the X

---

* $1/40 \geq t/L < 1/20$.

** $1/20 \geq t/L < 1/10$.

† $t/L \geq 1/10$.

†† FIESTA analyses only.

plane of symmetry. Plate geometry plots are shown in Figures 17, 18, and 19.

GTSTRUDL

34. Because of its shear deformation characteristics, the six-noded IPBQQ plate bending element with six DoF per node was selected to model the three plates. Shear deformation is negligible for thin plates but becomes more prominent as the plate becomes thicker. This is one reason why many thin plate elements prove too stiff near the thicknesses where shear deformations are no longer negligible. The IPBQQ element does not have thermal load capability nor can stress contours be plotted. These capabilities are available for FIESTA but were intended only to show additional capability and were not used for comparison. Previous convergence studies of the IPBQQ element indicated four rows of elements each way (16 total) were needed for convergence (Figure 20). Symmetry was modeled by allowing Z displacements along the planes of symmetry, restraining the X moment along the Y plane, and the Y moment along the X plane of symmetry.

Comparison

35. Both codes are easy to use. Loading the FIESTA elements and describing boundary conditions were easily done using the surface options.

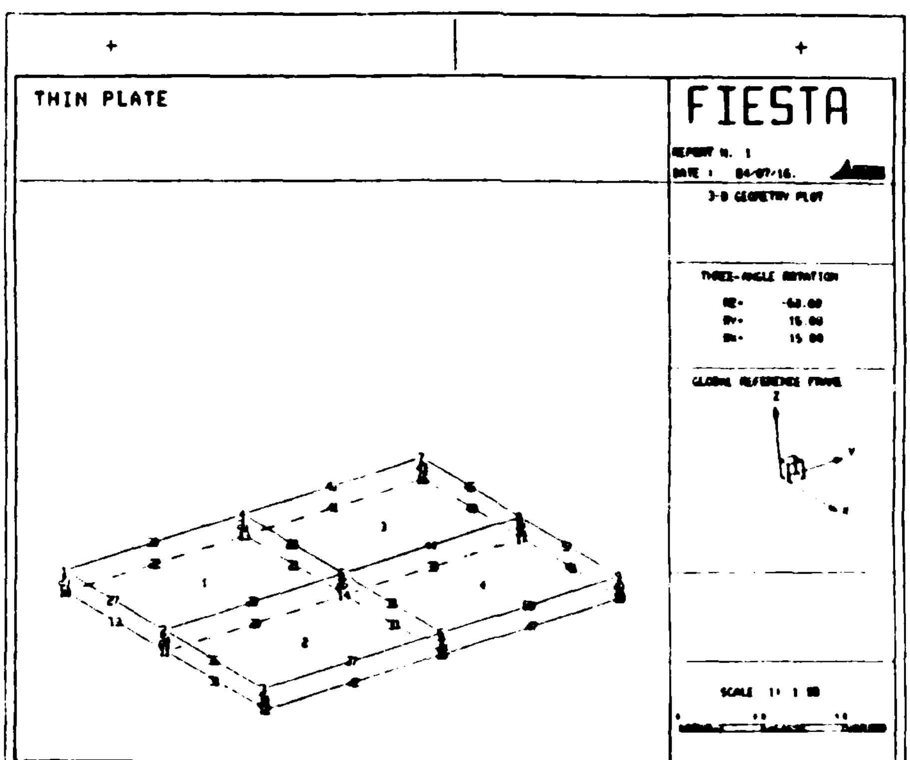

Figure 17. Thin plate geometry plot

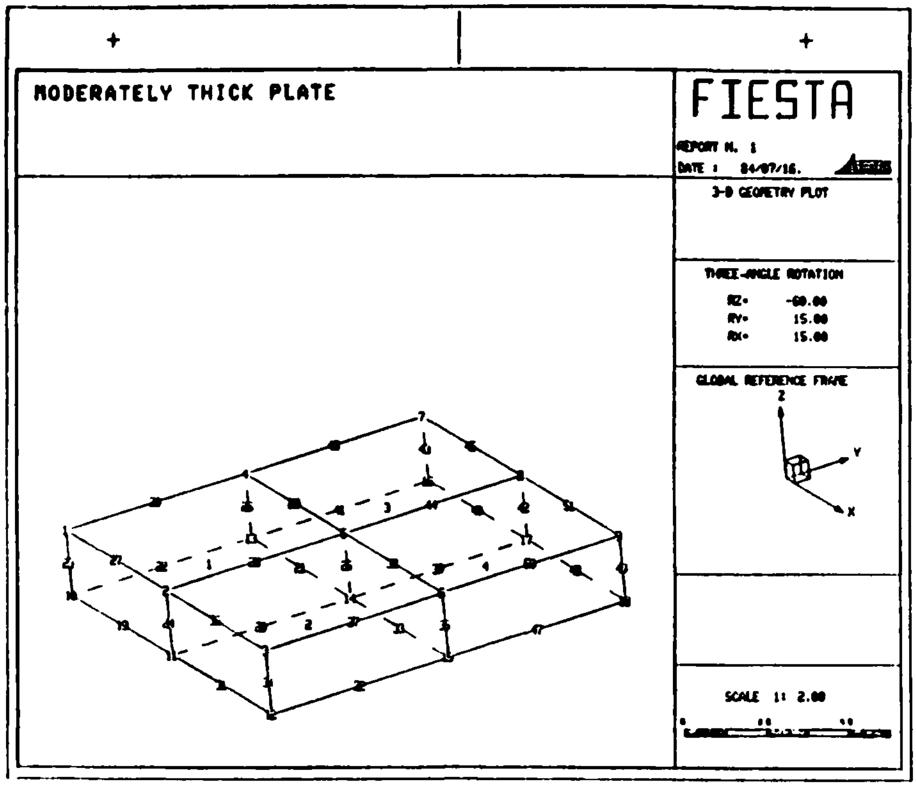

Figure 18. Moderately thick plate geometry plot

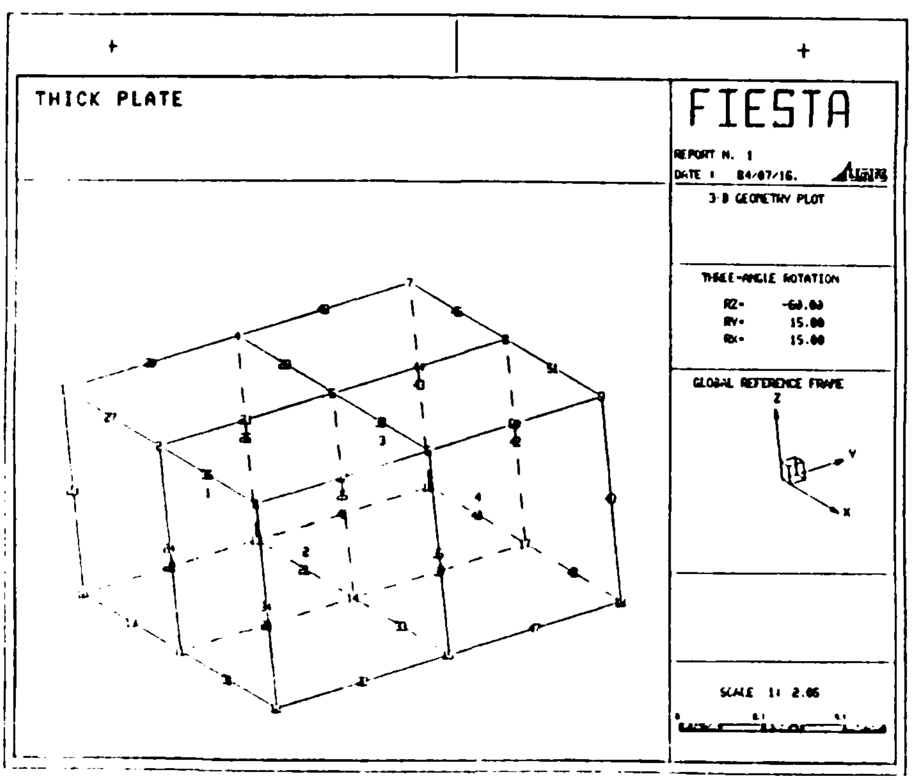

Figure 19. Thick plate geometry plot

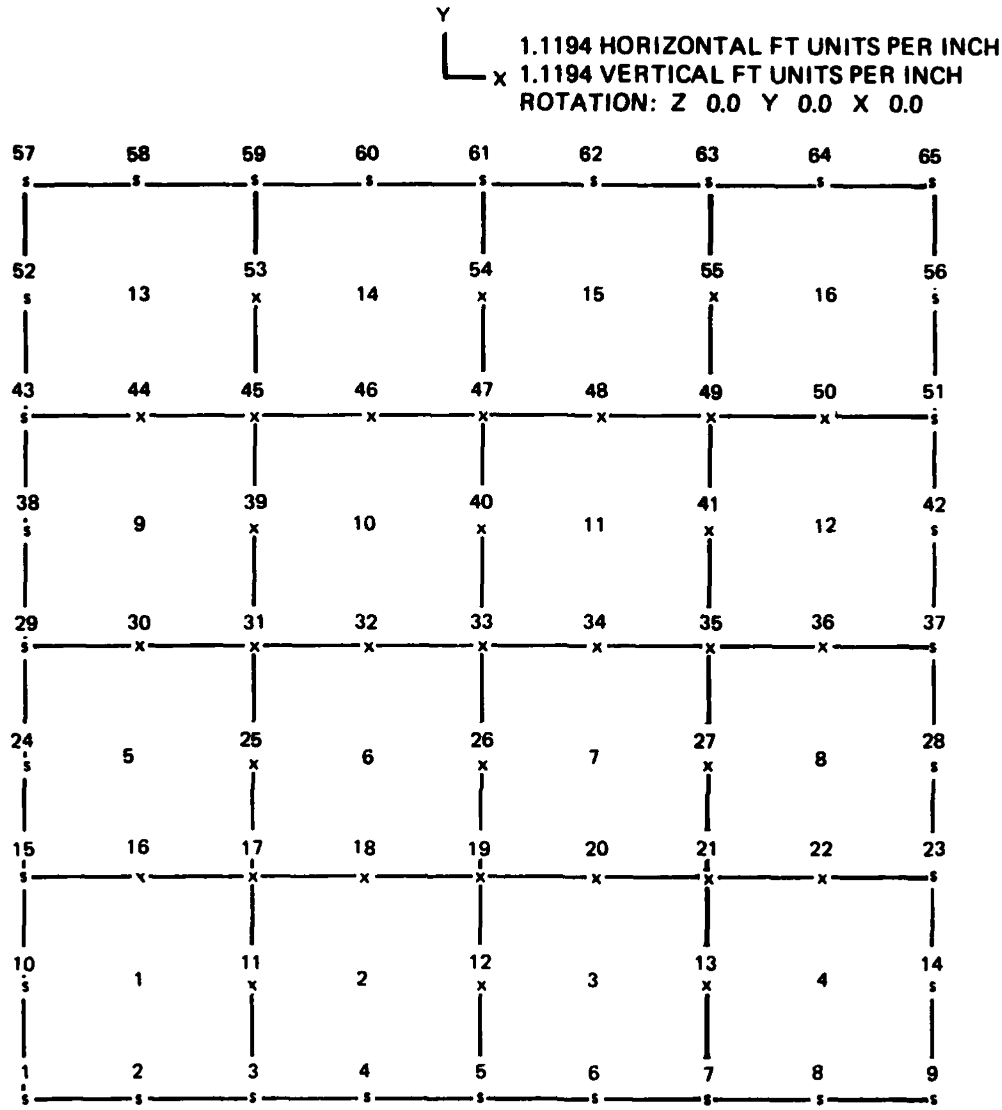

Figure 20. Four rows, horizontal and vertical, necessary for convergence

Geometry analysis to check input grid geometry is good practice regardless of the FE code selected; however, to use the surface option of FIESTA, geometry analysis is a requirement since surfaces cannot be hand-determined in advance. FIESTA required that all geometry and output plotting commands be included in the input file since an independent plotting program was used to display the plots. GTSTRUDL allows the option of including plot commands in the input file for batch plotting or restoring the data base and interactively issuing the plot commands.

Results

36. Input files and stress contour plots for FIESTA and input files for GTSTRUDL are contained in Appendix D. Appendix E contains thin plate theoretical calculations for the 100-psf uniform load and dead load. The number of DoF for the GTSTRUDL model fell between the number of DoF for FIESTA P-levels 4 and 5. FIESTA data needed for comparison with GTSTRUDL data were obtained by linearly interpolating between P-levels 4 and 5 results to obtain FIESTA data for the same DoF as the GTSTRUDL data. These computations are contained in Appendix F.

Comparison

37. Condensed results of center plate displacement for all plates for the 100-psf uniform load and dead load are shown in Table 4. Appendix F contains the results for all P-levels. Data needed to calculate theoretical displacements for fixed moderately thick and thick plates were not available. Pinned plates for which the required data were available were considered, but FIESTA does not allow a midside node to be constrained without constraining both adjacent vertex nodes. Theoretical results are for the midplane of the plate and the FIESTA model had no vertex nodes on this plane. GTSTRUDL does not have this problem for the IPBQQ element since the grid is defined as the midplane surface and is given a specified thickness. The thin plate FIESTA results were closer to the theoretical than the GTSTRUDL results (0.55 percent error compared to 1.33 percent error). The differences were very small and the results were identical to four significant digits. GTSTRUDL predicted more displacement than the theoretical, while FIESTA predicted less displacement. Moderately thick and thick plate results compared very well between the two codes. This verifies that FIESTA's 3-D tetrahedron element gives reliable results for plates of any thickness.

38. Information in the FIESTA Training Manual dated 28 January 1983 published by MCAUTO leads engineers to believe that by performing a P-level sweep, varying P-levels for the same grid, limiting values of computed data (potential energy, stress, displacements, etc) can be extrapolated for the mesh with infinite DoF. FIESTA experts indicated that the training manual is incorrect in showing curves, extrapolating the predicted limiting values for displacements and stresses. Displacements and stresses do not converge monotonically and should not be extrapolated. The best way to check

Table 4

Center Plate Displacement

	100-psf Uniform Load		Dead Load	
Thin Plate	Displacement	Error, %	Displacement	Error, %
P-level 4 (156 DoF)	-0.000420	1.33	-0.001029	2.22
P-level 5 (244 DoF)	-0.000429	0.15	-0.001051	0.13
FIESTA* (227 DoF)	-0.000427	0.55	-0.001047	0.54
GTSTRUDL (227 DoF)	-0.000435	1.33	-0.001067	1.32
Theoretical	-0.000430	--	-0.001053	--
Moderately Thick Plate				
P-level 4 (156 DoF)	-0.0000170	N/A	-0.0001252	N/A
P-level 5 (224 DoF)	-0.0000173		-0.0001271	
FIESTA* (227 DoF)	-0.0000172		-0.0001267	
GTSTRUDL (227 DoF)	-0.0000174		-0.0001277	
Thick Plate				
P-level 4 (156 DoF)	-0.000000844		-0.00002089	
P-level 5 (224 DoF)	-0.000000855		-0.00002112	
FIESTA* (227 DoF)	-0.000000853		-0.00002108	
GTSTRUDL (227 DoF)	-0.000000814		-0.00001994	

* Linearly interpolated values, Appendix F.

convergence of these values is to check the agreement between results of successive runs of increasing the P-level or modifying the grid.

Potential energy predictions

39. The FIESTA Training Manual shows predictions for convergence of potential energy. FIESTA experts agree that potential energy, which is related to strain energy used to derive the element stiffness matrices, is the only data that can validly be extrapolated. They further agree that error estimation based on potential energy is useful and meaningful only for indicating the general quality of approximation. Figures 21, 22, and 23 show this type prediction for 100-psf uniform loadings on the three plates. Curves are shown in the FIESTA Training Manual, plotting percent error in potential energy versus DoF for FIESTA and an H-version FE code (GTSTRUDL is an H-version code). However, these types of curves were not developed because of the uncertainty of choosing the converged potential energy and then using this value to calculate the percent of error. FIESTA experts recommend using only P-levels 2, 4, and 6 for convergence studies. The polynomial being assumed as the shape function, P-level 2 corresponds to a second-order polynomial, P-level 4 to a third-order, and P-level 6 to a fourth-order. P-levels 1, 3, and 5 borrow terms from the next higher P-level shape function. From the recommendation that only P-levels 2, 4, and 6 be used for convergence, it appears that P-levels 1, 3, and 5 should be used just as transition levels between recommended P-levels.

Cost calculations

40. Cost comparison calculations between FIESTA and GTSTRUDL are very misleading. A true comparison could be made only if human effort were measured and if both codes were on the same computer system. FIESTA runs on the overnight priority for P-level 5, the most expensive, were $21.52, and the GTSTRUDL cost for the analysis of 227 DoF on the overnight priority was $0.25. This reflects only the computer cost of the two systems.

Display of results

41. Display of FIESTA results was done by an independent program called IPFVIEW. This program displays the stress-contour interval in a fixed format. As can be seen in the 50-deg temperature change plots in Appendix D, problems occur when the interval value exceeds the allotted fixed field (asterisks are printed). A better approach may be to output the stress intervals in an exponential format. Another approach is to request more intervals; however,

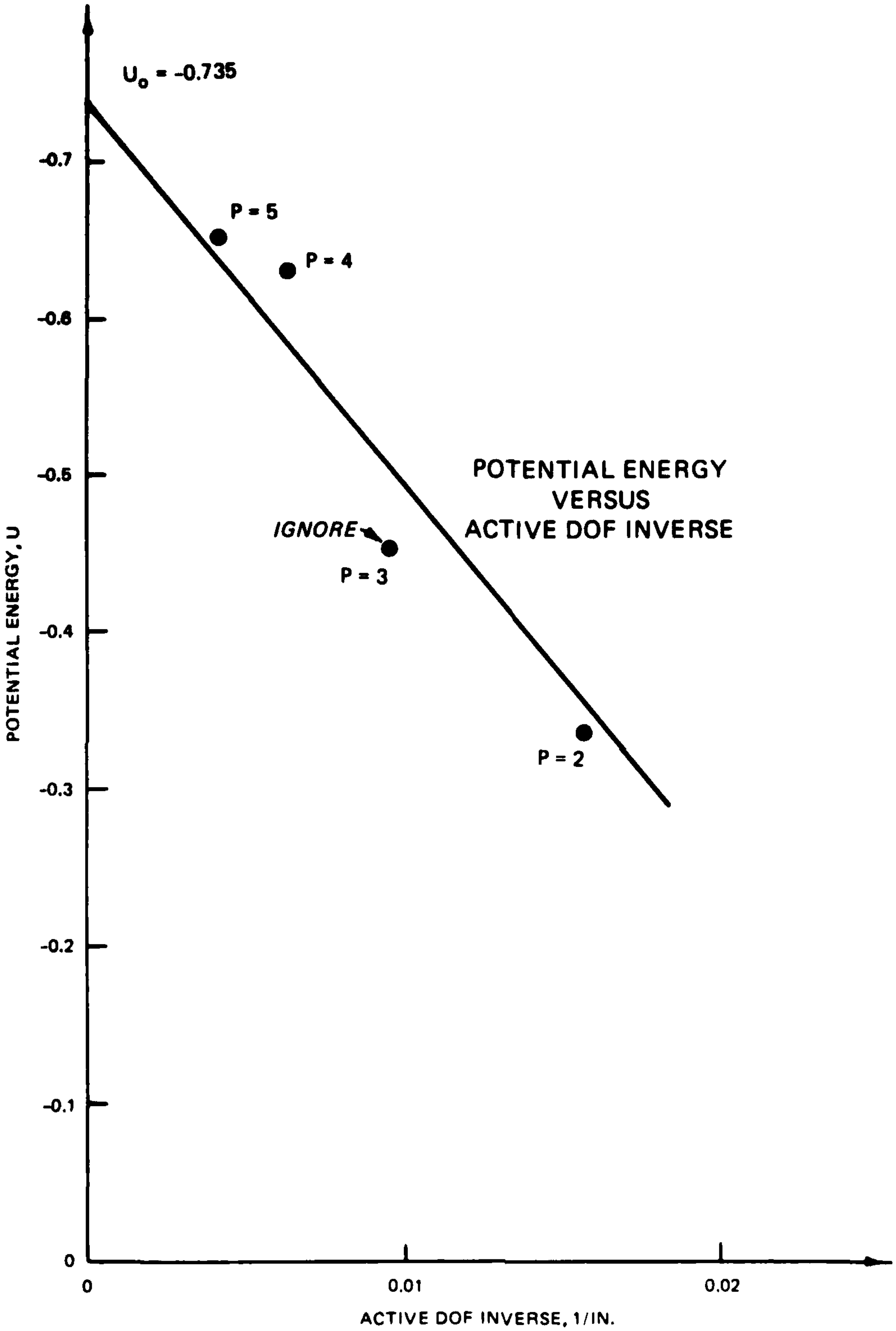

Figure 21. Thin plate, 100-psf uniform load

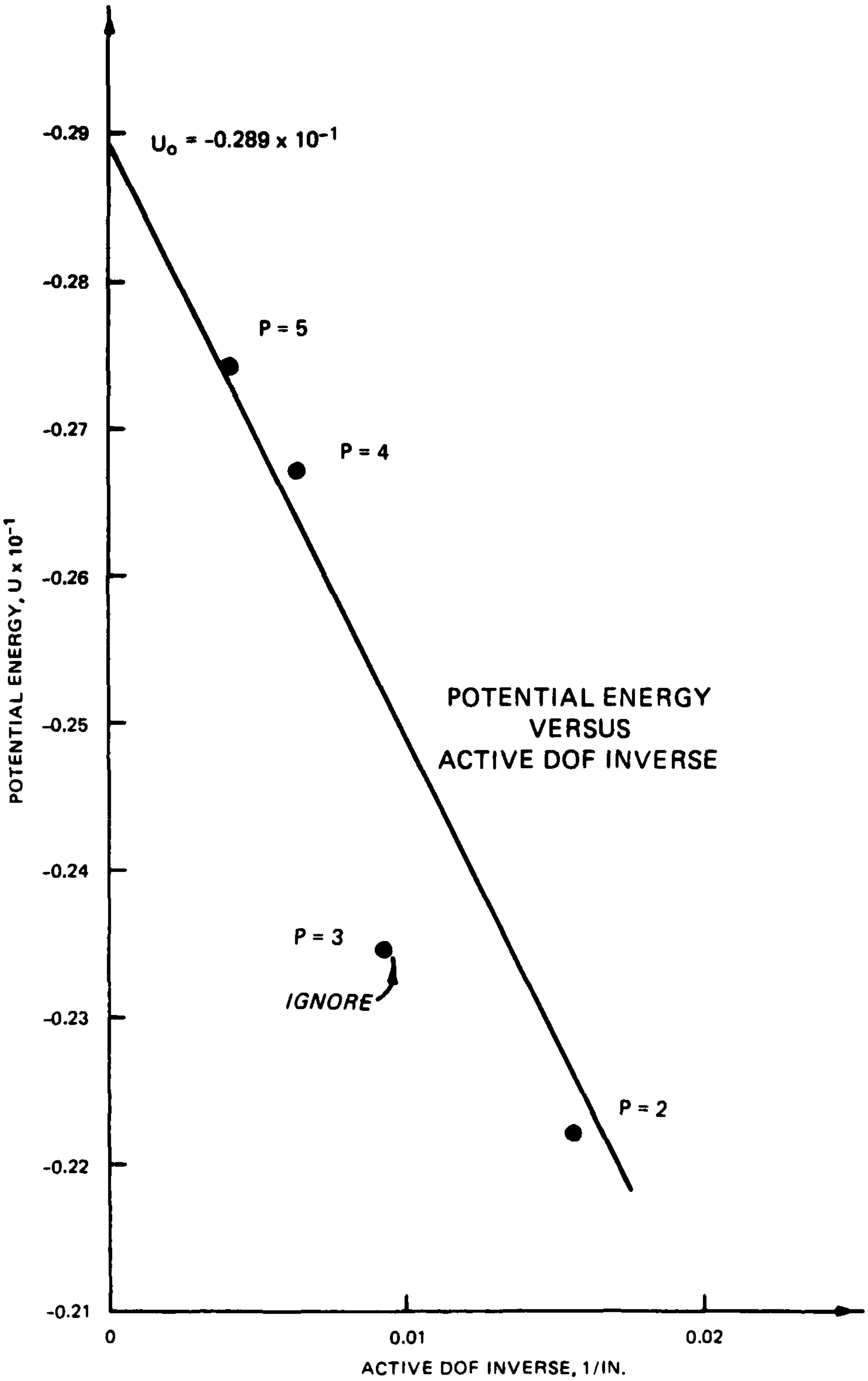

Figure 22. Moderately thick plate 100-psf uniform load

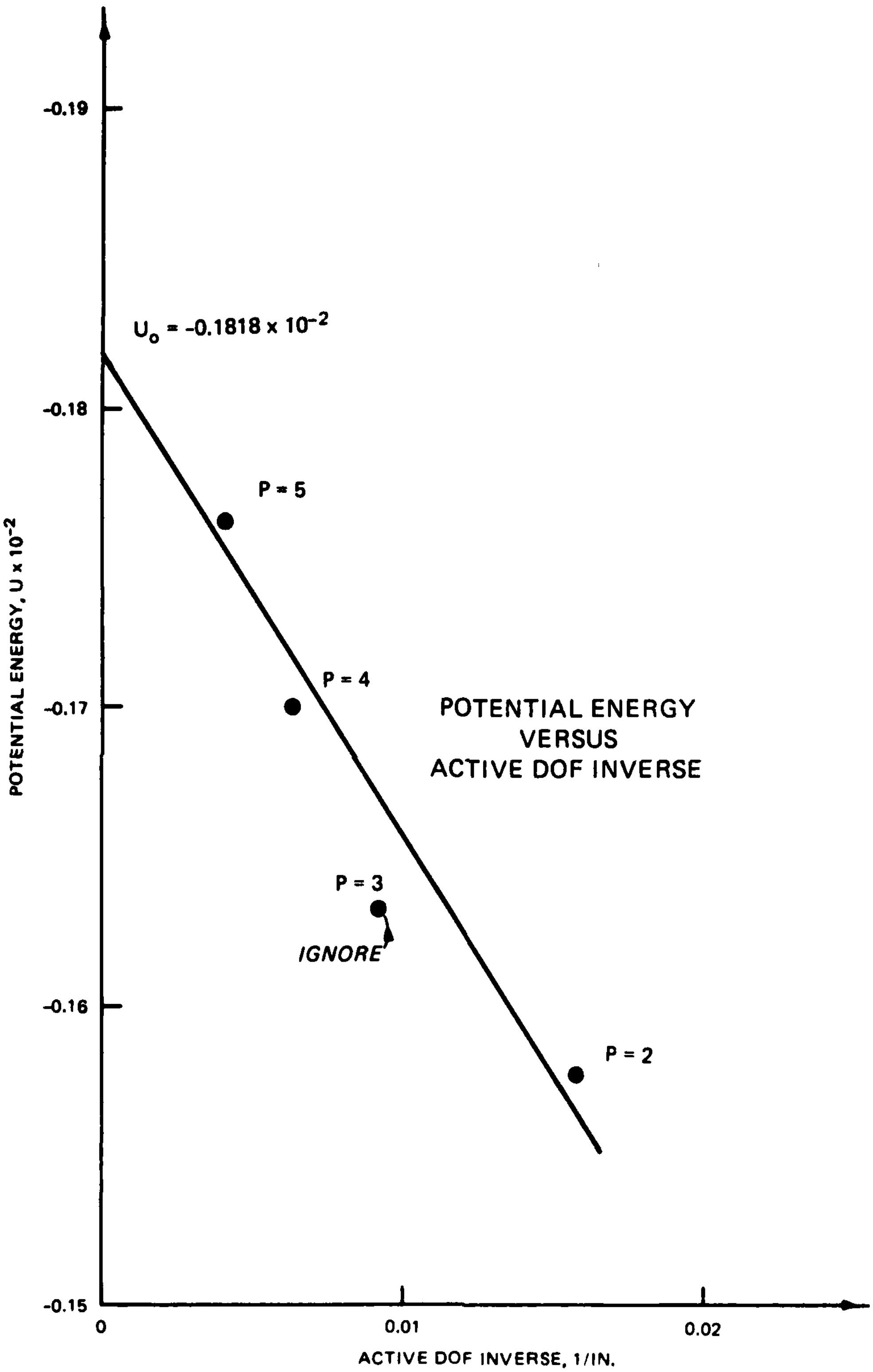

Figure 23. Thick plate, 100-psf uniform load

this might clutter an already sufficiently fine stress plot. All plotting for GTSTRUDL is done by GTSTRUDL and does not require an independent plotting program for the display of results.

Conclusions

42. The 3-D tetrahedron element of FIESTA gives good results (consistent with GTSTRUDL's IPBQQ element and thin plate theoretical results) for all three classes of plates. It is recommended that no fewer than two rows of elements (each way) and at least a P-level of four be used to model solid plates. Holes in plates would require more elements.

43. Prediction of convergence by plotting displacements and stresses from previous analysis are invalid and should not be used. Computer costs for the size of FIESTA problems were not large. Data for the analyses were easy to assemble and the grid refinement from changing P-levels was much easier than H-version methods of grid refinement.

PART IV: ASPECT RATIO STUDY

Effects on Problem Solutions

44. FE users are concerned with the effect a poor aspect ratio has on the solution of a particular problem. The aspect ratio can be defined as the ratio of the largest to smallest dimension of an individual element. For a typical H-version element the aspect ratio must not exceed four. This study deals with the effect of the aspect ratio when using FIESTA.

45. The problem shown in Figure 24 is used for this study. Since the problem is symmetrical about the horizontal line through the middle and a

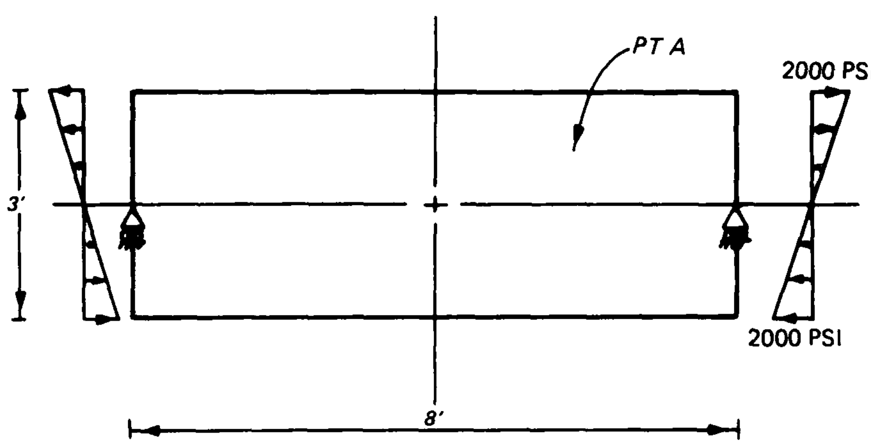

Figure 24. Beam problem for evaluating aspect ratio

vertical line at the center line, only a quarter model is used. Table 5 gives all the results for this study. The column labeled N refers to the number of elements through the depth of the quarter model. Grid I has a single element extending the length of the quarter model. Figure 25 displays grid I for N = 4 . Grid II has two elements along the length of the quarter model. Figure 26 displays grid II for N = 4 .

46. From the results seen in Table 5, there is no indication that FIESTA is sensitive to aspect ratios. However, there are differences between grids I and II. This again shows the sensitivity of FIESTA to the grid. The use of a single element across a model is not valid for any FE code. All grids and plots of results are in Appendix G.

Table 5

Aspect Ratio-Beam Problem

Grid	N	Aspect Ratio	P-Level	Point A X Displacement	Point A Y Displacement	Cost ($)
I	4	10.67	2	0.63447 E-5	-0.38311 E-6	10.93
	10	26.67	2	0.63484 E-5	-0.37588 E-6	16.30
	20	53.33	2	0.63490 E-5	-0.37476 E-6	27.35
	40	106.67	2	0.63492 E-5	-0.37448 E-6	49.64
	4	10.67	4	0.64330 E-5	-0.34745 E-6	15.31
	10	26.67	4	0.64349 E-5	-0.34683 E-6	27.24
	20	53.33	4	0.64353 E-5	-0.34628 E-6	48.76
	40	106.67	4	0.64355 E-5	-0.34611 E-6	79.62
II	4	5.33	2	0.64961 E-5	-0.62547 E-6	13.95
	10	13.33	2	0.64999 E-5	-0.62010 E-6	24.94
	20	26.67	2	0.65005 E-5	-0.61931 E-6	44.44
	40	53.33	2	0.65007 E-5	-0.61911 E-6	66.03
	4	5.33	4	0.65129 E-5	-0.56277 E-6	23.11
	10	13.33	4	0.65174 E-5	-0.56085 E-6	46.52
	20	26.67	4	0.65188 E-5	-0.56006 E-6	88.29

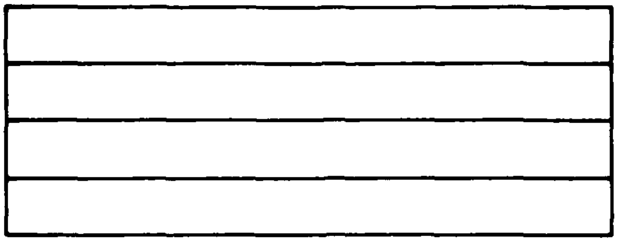

Figure 25. Grid I for N = 4

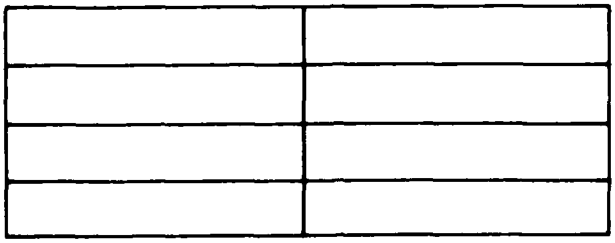

Figure 26. Grid II for N = 4

Basic Guidelines

47. The results in Table 5 show grids I and II converging to different solutions. The results for grid II are correct while grid I is converging to an incorrect solution. This illustrates that increasing the P-levels will not solve all mesh convergence problems. However, the authors of PROBE have suggested the following basic guidelines for 2-D grids using the P-level FE:

a. Keep aspect ratio less than 20:1.

b. Provide refinement of grids at corner where results within an element are desired.

c. Keep curved areas within an element 45 deg or less.

d. Keep internal angles within an element 160 deg or less.

e. Avoid using point supports.

These simple rules will result in adequate grids for most problems and would have prevented the use of grid I.

PART V: THREE-DIMENSIONAL STUDY

Objective

48. Since FIESTA is truly a 3-D FE code, this phase of the study was designed to evaluate its 3-D capabilities. GTSTRUDL was used for comparison.

Problem

49. An intermediate pier for Red River Lock and Dam No. 3 was selected because the complex geometry and loads required 3-D analysis rather than a 2-D approximation. Figures 27 and 28 show the structure.

Modeling

50. Different meshes were designed for the FIESTA and GTSTRUDL analyses. Each mesh reflected sound engineering judgment based on the capabilities of each code. Node and element generation techniques were used whenever feasible.

FIESTA

51. A plot of the FIESTA grid showing the global coordinate axes is shown in Figure 29. FIESTA has the capability of handling larger (thus, fewer) elements, but because of loads and geometry, it was difficult to layout a nodal pattern that was conducive to the nodal generation capability of FIESTA. FIESTA can only generate nodes that are equally spaced or that are geometrically graded. The only regularly occurring spacing was in the Z direction (each node on the X-Y plane equal to zero can be thought as being projected in the Z direction at different intervals to obtain other nodes). A typical sequence to generate these nodes is:

```
1   0.   0.   0.
3   0.   0.   30.   ,   ,   1   3   1
4   0.   0.   34.5
5   0.   0.   39.
7   0.   0.   69.   ,   ,   1   3   1
```

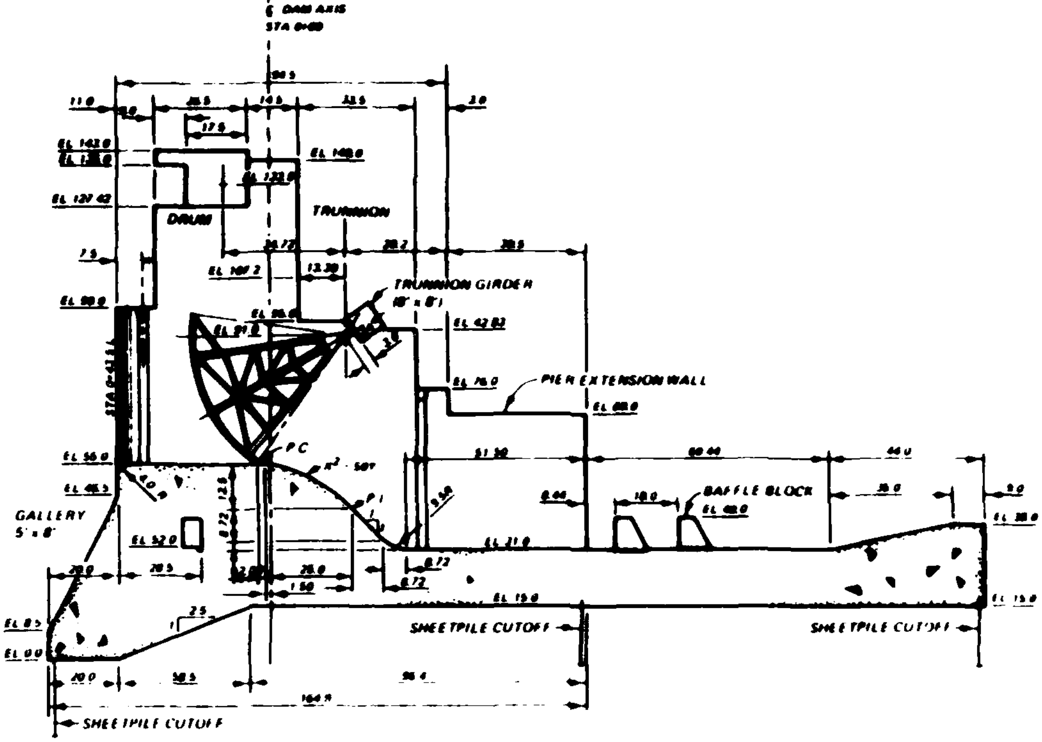

Figure 27. Dam section

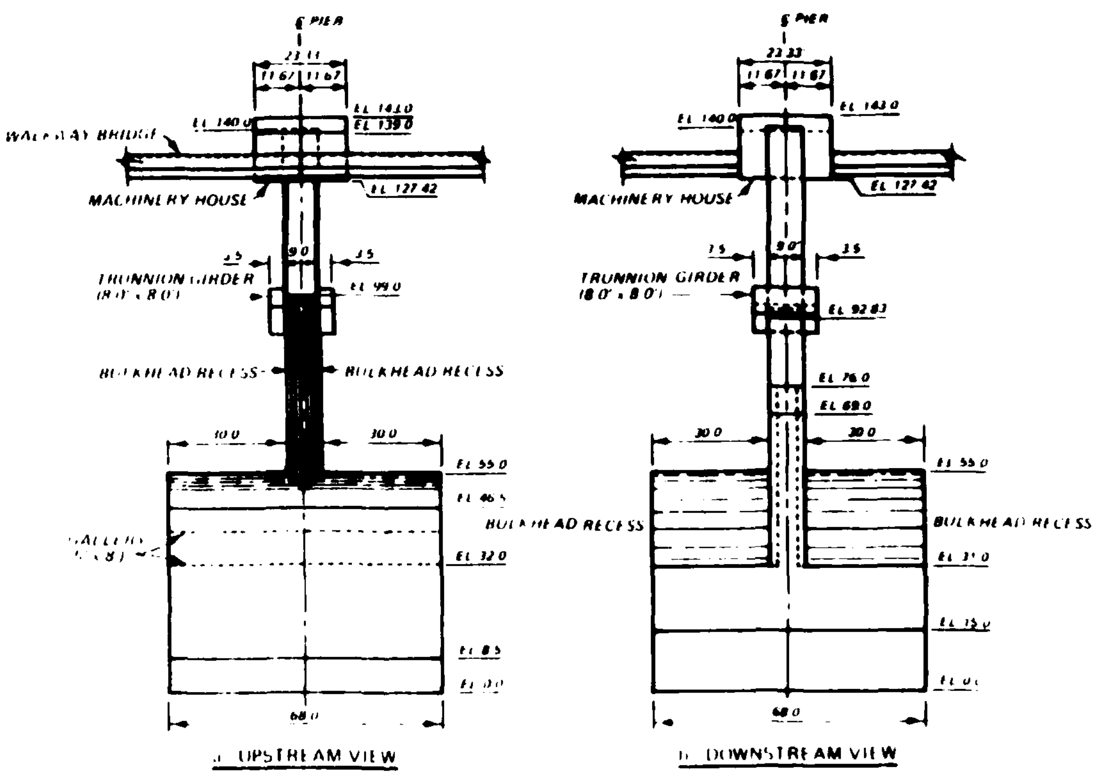

Figure 28. Dam elevation

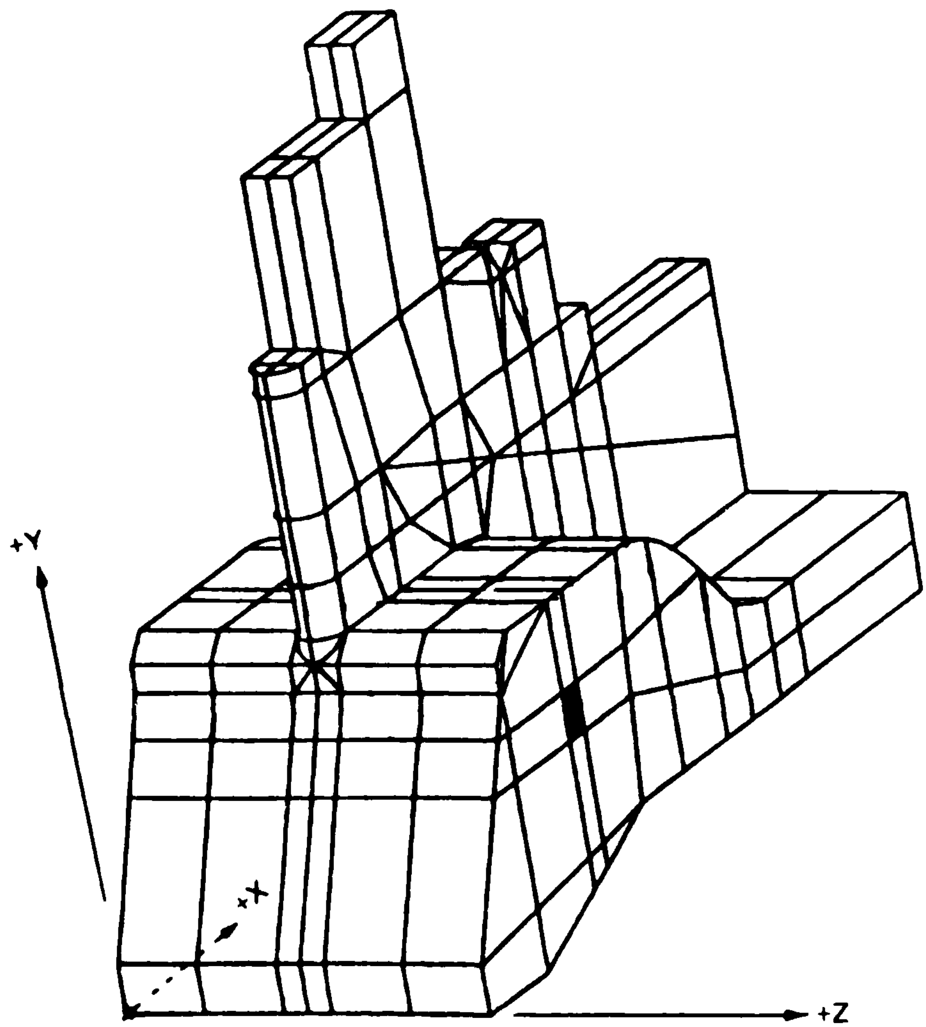

Figure 29. Plot of FIESTA grid with global coordinate axes

These five lines describe the location of nodes 1 through 7. These nodes represent the lower upstream corner (starting at 0., 0., 0.) of the model. The first line shows the first node and its coordinates. The second line shows the last node in the generation sequence, its coordinates, the node number increment, the number of points to be generated, and the scaling factor. The scaling factor indicates equal spacing (equal to 1) or the geometric grading. The data file containing the nodal input is shown in Appendix H. FIESTA can generate regular grids in one, two, or three levels (directions).

52. Elements were also generated whenever possible (usually in the Z direction). Restrictions are that all nodes must have the same increment and the element increment number is always one. A sequence to generate elements containing the lower upstream corner is:

```
31   1   1   29   36   8   2   30   37   9
-1   6   1
```

The first line shows the element type, element number, and the vertex nodes describing the element. The second line has the element generation key, the number of elements to be generated, and the node increment. FIESTA can generate elements in three levels (directions). Elements used were hexahedron types 31 and 32, pentahedron types 21 and 22, tetrahedron type 12, and pyramid type 42. These elements are shown in Figure 30. The input file containing the element definitions is in Appendix H. All elements in the FIESTA element library contain midside nodes. However, FIESTA permits manual input of these nodes, automatic generation of those nodes, or a combination of both. In order to reduce the amount of manual input, only the midside nodes required to define curved surfaces were manually input. All other midside nodes were automatically generated.

<u>GTSTRUDL</u>

53. A plot of the GTSTRUDL grid showing the global coordinate axes is shown in Figure 31. Since more elements were required and due to more flexible nodal generation capability, more nodes were generated. GTSTRUDL generation of the same nodes used in the FIESTA example are:

```
1   0.   0.   0.
7   0.   0.   69.
GENERATE BETWEEN   1   7   ID   2   INC   1
XD  6  PARTS ARBITRARY   15.   15.   4.5   4.5   15.   15.
```

The first two lines define the coordinates of the first and last nodes. Line 3 instructs the program to generate nodes between 1 and 7 beginning with node 2 and incrementing by 1. The last line tells how many parts and the relative lengths the distance from node 1 to node 7 is to be divided into. GTSTRUDL can also generate nodes in one, two, or three directions.

54. GTSTRUDL element generation was also used. Commands to generate the same elements shown for FIESTA are:

```
GENERATE  6  ELEMENTS  ID  1,  1 FROM  1  1  TO  29  1  TO -
36  1  TO  8  1  TO  2  1  TO  30  1  TO  37  1  TO  9  1
```

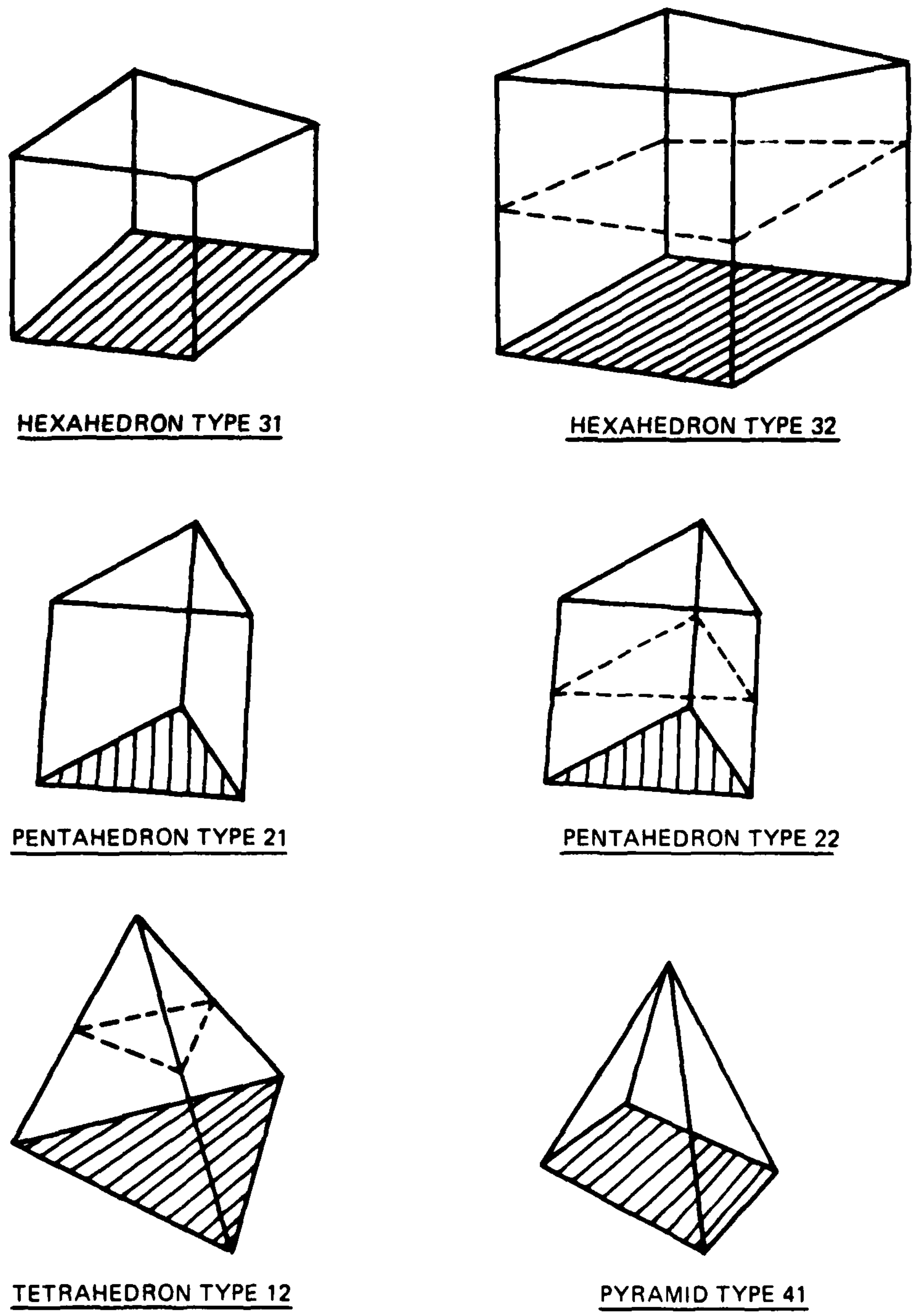

Figure 30. FIESTA elements

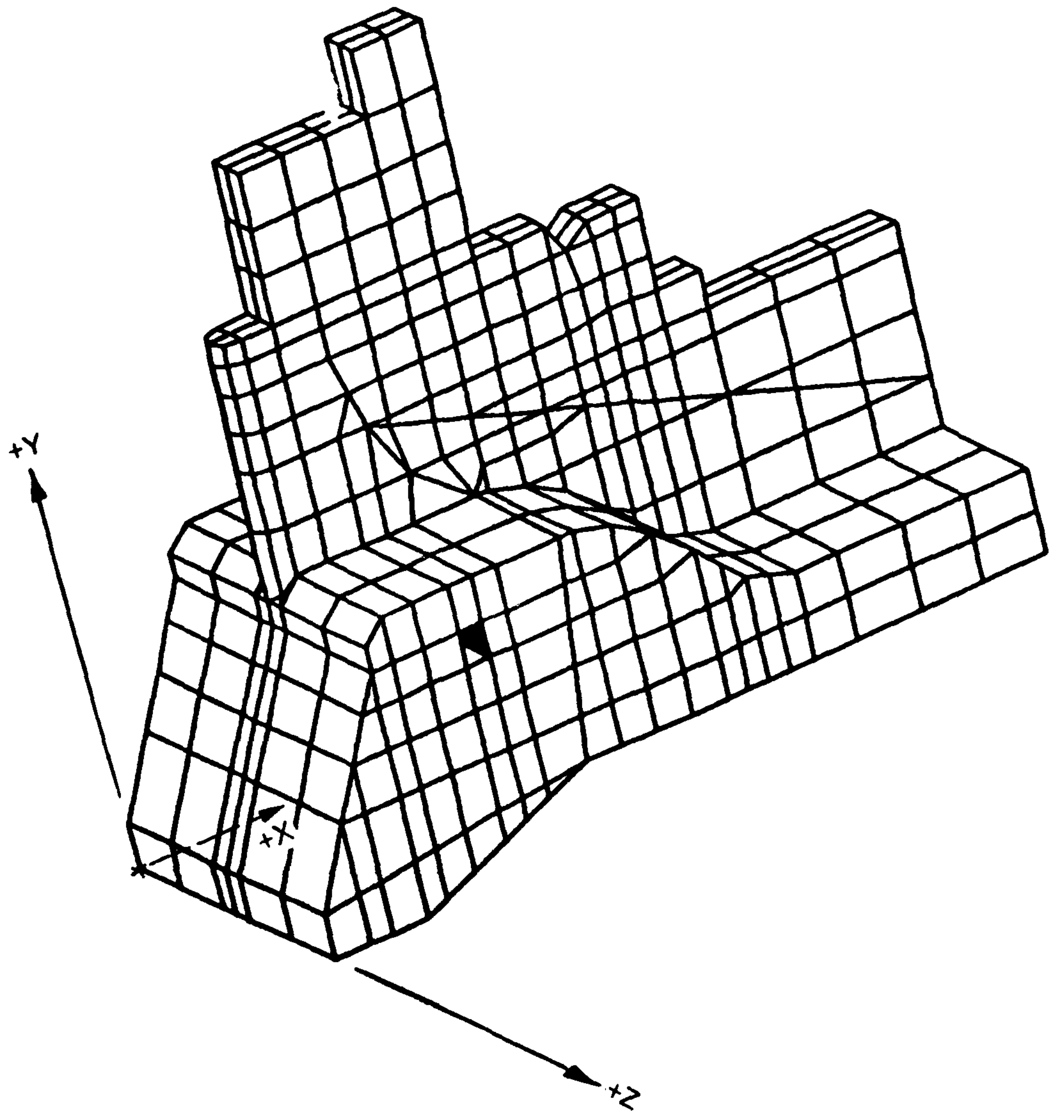

Figure 31. Plot GTSTRUDL grid showing global axes

Since the nodal increment for each node is given, different increment values are possible as are element increments. Eight-noded IPLS and six-noded TRIP elements were used. These elements are shown in Figure 32 with the element input file in Appendix H. Since no midside nodes are used for these elements, no curved surfaces could be modeled. This increased the number of elements used to more closely approximate the curves.

Comparison

55. The FIESTA data was less than the GTSTRUDL data, but the more powerful generation capability of GTSTRUDL lessened this effect. It is believed that if identical grids were entered, GTSTRUDL would be easier to use. FIESTA

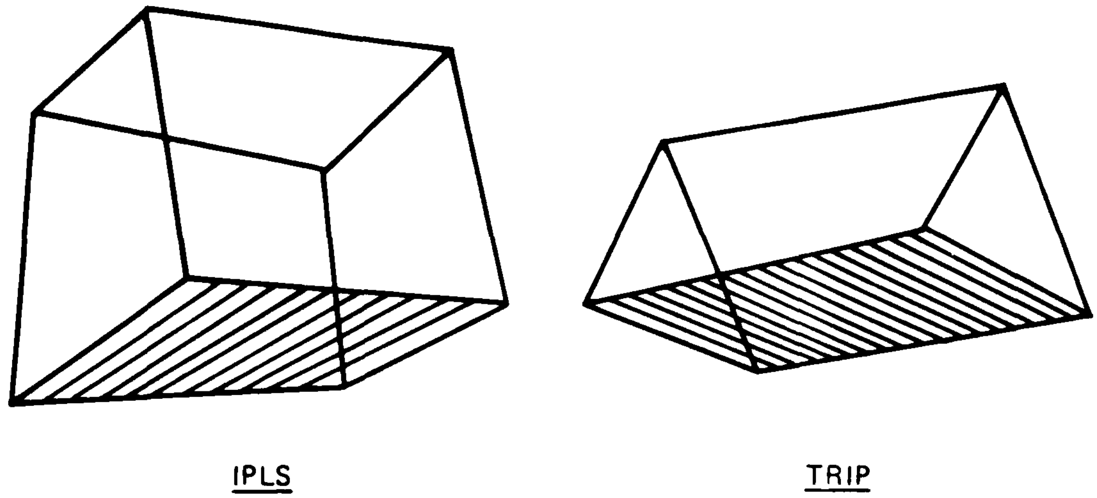

Figure 32. GTSTRUDL elements

can generate only element types 31, 3101, 32, and 3201 (brick type elements), while GTSTRUDL can use generation for any element between nodes. Reducing the amount of input by allowing the computer to generate midside nodes eliminates the capability of generating type 32. Vertex and midside nodes will not have the same increment.

56. FIESTA would be greatly enhanced if it were capable of variation of nodal increment and element increments more than one for element generation and arbitrarily spaced node generation.

Boundary Conditions

57. Boundary conditions were identical for FIESTA and GTSTRUDL. The base of the model was totally fixed except for the lower upstream corner which was free in the X direction. This was done to include the horizontal loads acting on these nodes. The vertical boundary at the center of both tainter gate bays was restrained in Z direction only. Since each node has only three DoF with no rotation possible, this modeled symmetry along these boundaries. The downstream vertical face, the portion in contact with the stilling basin slab, was left free. This was done since normally a compressible joint filler is used and the slab usually is considered not to add any restraints.

FIESTA

58. FIESTA has the capability of adding restraints by nodes, faces, or surfaces. The user has the flexibility to define how the faces are grouped into surfaces. Surface restraints were used for the symmetry boundary, nodal

restraints for the lower upstream corner of the base, and face restraints for the remainder of the base. The program requires restraint of all midside nodes with restrained common vertex nodes. When face or surface constraints are used, the program automatically applies the specified constraints to vertex and midside nodes.

GTSTRUDL

59. GTSTRUDL constraints can be input only for individual nodes. However, the list capability allows similar restraints to be placed on many nodes with minimal additional input. GTSTRUDL can also release constraints that have previously been imposed.

Comparison

60. The flexibility of FIESTA makes the input of constraints easier. However, an initial run is necessary to determine face and surface numbering, if these capabilities are to be used. FIESTA could be further enhanced if constraint releases were possible. Then the base could have been totally restrained using the surface capability and the upstream nodes selectively released in the X direction.

Plotting

61. FIESTA has the capability of plotting input geometry as well as output. GTSTRUDL cannot plot output, therefore only input geometry plotting capabilities are compared.

FIESTA

62. FIESTA can generate only batch plot files. For 3-D meshes, this means selecting the viewing angle in advance. Instructions in the user's manual on obtaining the rotation values for the desired viewpoint were difficult to follow. Consequently, several rotational combinations were used to get a view that adequately showed the structure. A plot of the mesh using IPFVIEW is shown in Figure 33.

GTSTRUDL

63. GTSTRUDL can plot input interactively or create a batch plot. The batch plot has the same restrictions as FIESTA, however the interactive plotting allows easy change of the viewpoint to get the optimum viewing angle. Interactive plotting is much more expensive than batch plotting. A plot of the mesh is shown in Figure 34.

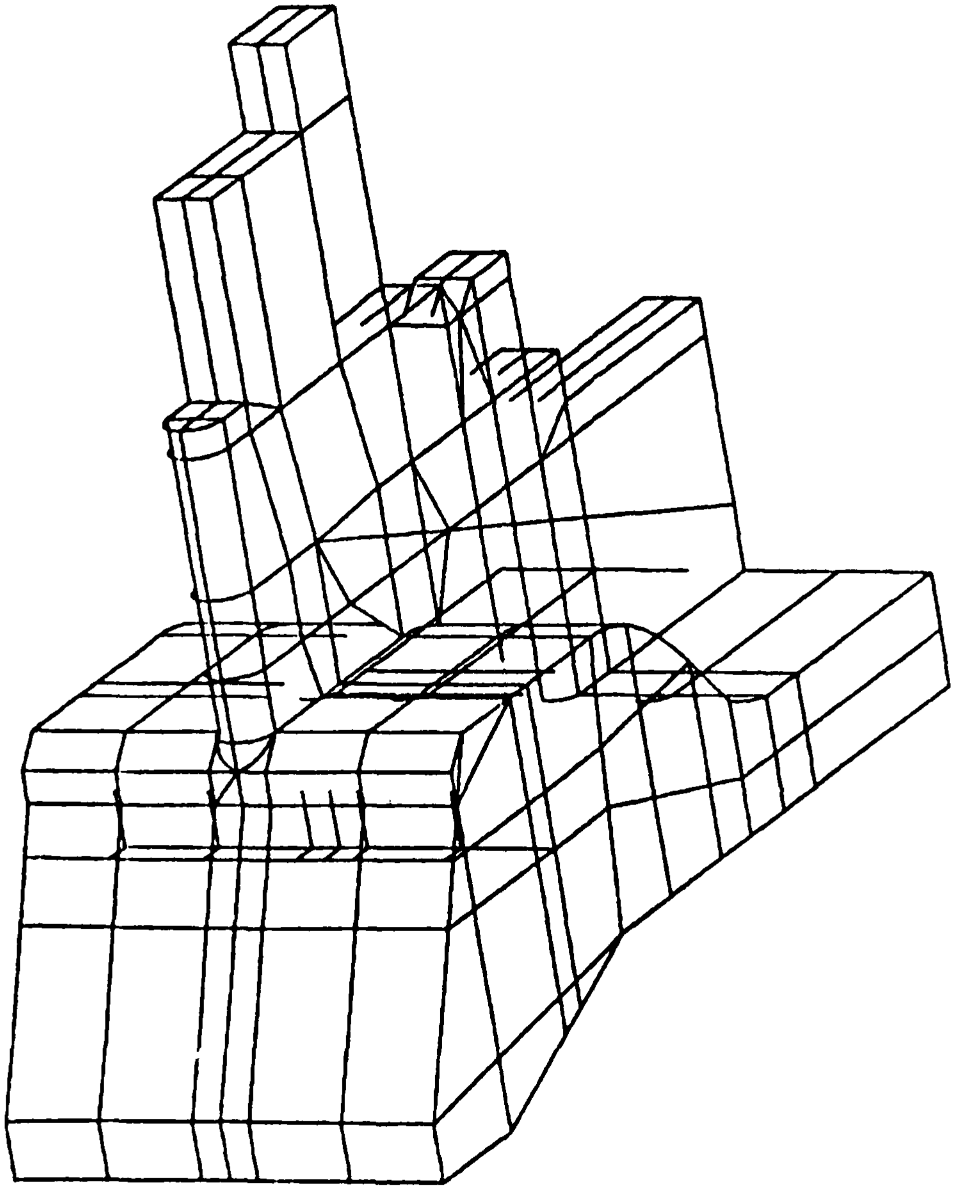

Figure 33. FIESTA mesh plot using IPFVIEW

Comparison

64. Both codes allow plotting of selective portions of the structure. This is very helpful for debugging complex meshes since plotting the total structure results in excessive overwriting, and this renders the plot useless.

65. The hidden line removal capability of IPFVIEW used for FIESTA inadequately removed all hidden lines as can be seen in Figure 33. It appears that the entire surface is plotted even though only a portion is visible.

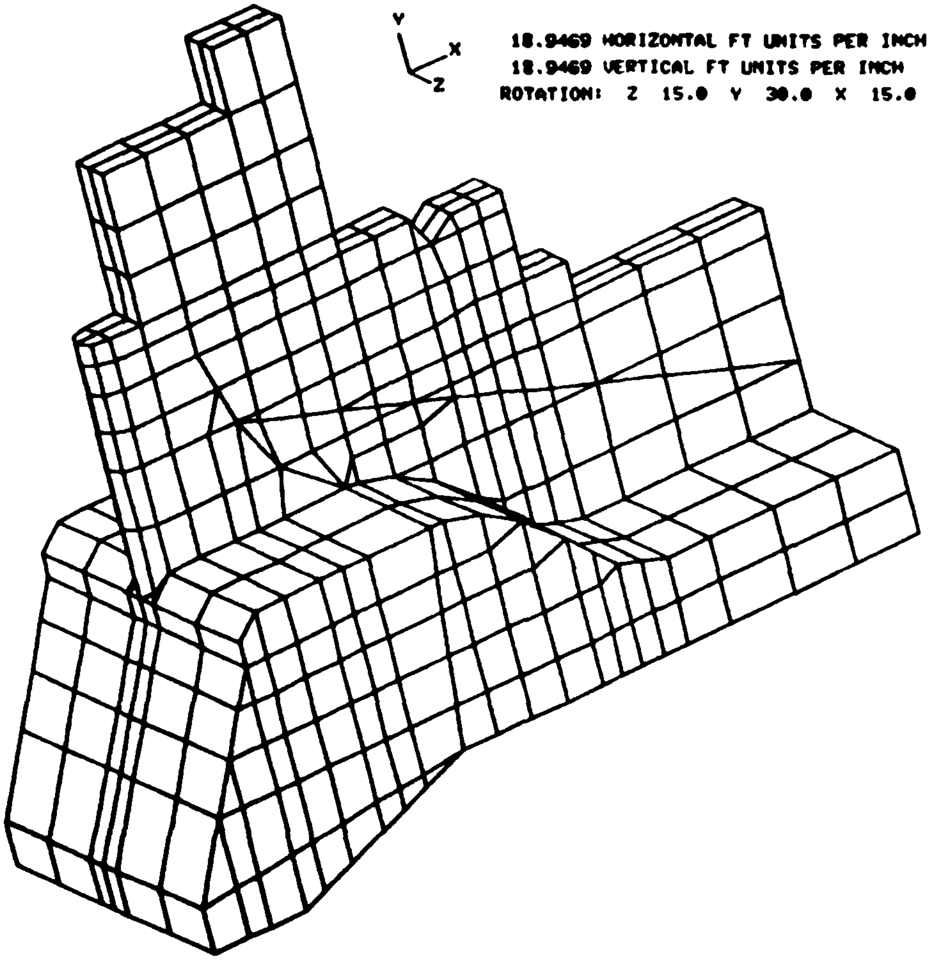

Figure 34. GTSTRUDL mesh plot

66. The ability of FIESTA to produce contour plots of the output is a necessity for all 3-D FE studies. The feature makes FIESTA a desirable code for a 3-D analysis.

Properties

67. The same material constants were used for both programs. They are as follows:

E = 3,122,000 psi (modulus of elasticity)

ν = 0.17 (Poisson's ratio)

γ concrete = 150 pcf (unit weight)

The concrete containing the stairwell that leads from the machinery house to the trunnion girder was modeled as a solid, to reduce mesh complexity, with

the material properties modified to reflect the stairwell. The modified material properties are:

$$E = 1{,}075{,}217 \text{ psi}$$

$$\nu = 0.17$$

$$\gamma \text{ concrete} = -51.66 \text{ pcf}$$

FIESTA

68. FIESTA required the use of consistent units. Therefore, since feet were used for nodal coordinates and pounds for loads, all constants were hand converted to foot and pound units. Density was also required, therefore the unit weight of concrete was converted to $(\text{lb/sec}^2)/\text{ft}^4$ units (unit weight $\div$ acceleration due to gravity).

69. FIESTA can analyze isotropic, transversely isotropic, orthotropic, and generally anisotropic materials.

GTSTRUDL

70. The ability to change units make it easier to enter material constants in their usual form. No hand calculations are required.

Comparison

71. Due to the ability to change units, GTSTRUDL more easily inputs material constants. FIESTA could be significantly enhanced if it allowed the user the freedom to change units.

Loads

72. For meaningful comparison of results, the input loads for each problem should be the same. Different loading capabilities of each program made direct comparison impossible prior to analysis. Load capabilities were used from each program that best modeled the applied loading conditions. Loadings are shown in Figures 35 and 36.

73. The soil loads were input as joint loads for both programs since the horizontal "K" factor made the horizontal component different from the vertical component. This eliminated the use of pressure loading, which is easier to input. Point loads were used to approximate the effect of the machine house, trunnion girder, and walkway dead weight. Modeling the machine house and trunnion girder would have increased the complexity of the model. Tainter gate loads were also applied as point loads for both programs.

FIESTA

74. Hydrostatic loading capability was very useful where there was a

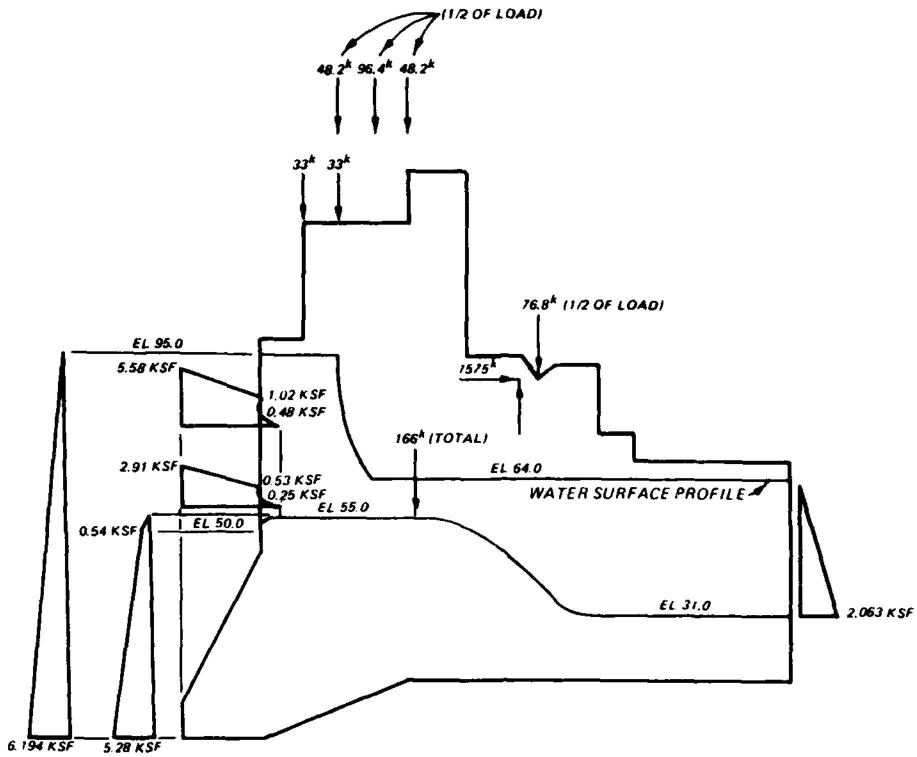

Figure 35. Loading for bay with tainter gate closed

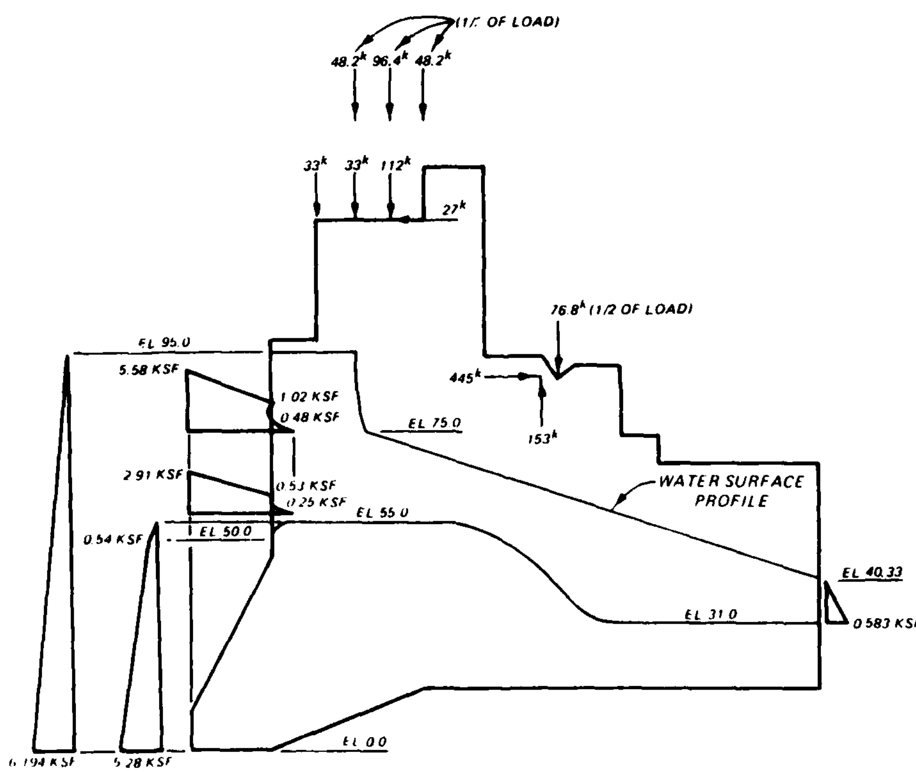

Figure 36. Loading for bay with tainter gate half open

constant head. Where the head sloped, due to the half-opened tainter gate, pressures were input at each node. For dead-weight loading, the user entered the acceleration due to gravity as the loading criteria.

GTSTRUDL

75. Load calculation was cumbersome since no automatic load calculation exists. All hydrostatic loads had to be entered as nodal pressures, except the hydrostatic load on the triangular faces of the trip elements. These had to be converted to joint loads, using tributary area, since GTSTRUDL does not recognize pressure loads on these faces.

Comparison

76. FIESTA has more powerful and efficient ways of entering load data than GTSTRUDL. An improvement for FIESTA would be the capability of providing a list of similarly loaded entities instead of its vertical generation. For example:

```
1  TO  5    -500.   0.   0.   0
```

instead of:

```
1   -500   0.   0.   0
2     =    =    =    =
3     =    =    =    =
4     =    =    =    =
5     =    =    =    =
```

This capability would greatly reduce the number of lines of input required. Data files containing loads for both FIESTA and GTSTRUDL are shown in Appendix H.

77. The relative closeness of the applied loads can be obtained by looking at the summation of reactions after an analysis. Those values and hand calculations are shown in Table 6. The hand calculation for the Z force

Table 6

Reaction Load Comparison

		FIESTA				GTSTRUDL	
Direction	Hand Calculation	P-Level 2	Percent Difference	P-Level 3	Percent Difference	Reaction	Percent Difference
X	-26,595,162	-26,580,000	0.1	-26,580,000	0.1	-25,319,050	4.8
Y	79,547,652	79,092,000	0.6	79,092,000	0.6	78,533,141	1.3
Z	1,274,329	1,433,500	12.5	1,433,500	12.5	1,375,588	8.0

is approximate, and the difference in computer and hand solution reflects this approximation. Considering the widely different manner in which their loads were input, the reactions are considered close enough to give realistic comparisons for displacements and stresses. However, these differences in reaction indicate that both programs need improved loading capabilities.

Analyses

FIESTA

78. The first portion of this study was done using Version 2, Update 8. Midway into the study Version 2, Update 11 was implemented. This required a list on entities to the processor "DISP" which resulted in Update 8 data files being inoperable on Update 11. It appears that upward compatibility is not a requirement in the update made to FIESTA. Upward compatibility is desirable since original designs often must be rechecked at short notice to analytically predict structural distress that has occurred. Data files were modified for Update 11 and debugging continued using P-level 1.

79. Toward the end of the study, MCAUTO changed computer complexes that were accessible to execute FIESTA. MCAUTO personnel did an inadequate job of converting procedures to the new complex and, consequently, the procedure used to execute FIESTA defaulted to execute the previous version of FIESTA (Update 8). Data files were converted to the Update 8 format. P-level 2 was reanalyzed, since the "ALL BUT" list capability was not operable in the processor "PROP". This causes elements to show up in two different element property lists. The FIESTA User's Manual is in error since it states that all list capabilities are operable in "PROP".

80. The next step performs an analysis at a higher P-level to check convergence of results. Since the FIESTA manuals give more credence to even P-levels, P-level 4 was selected. The analysis using Update 8 revealed the wavefront was too large (required memory exceeded available memory) for a P-level 4 analysis. FIESTA has no automatic wavefront reduction capability, so a cyclic manual procedure of entering an assumed order of elements in the processor "P-LEVEL" was attempted. Another error in the user's manual emerged, since Update 8 did not have this element reordering capability. MCAUTO FIESTA support personnel indicated Update 11 had this capability and told how to override the default of Update 8 and execute Update 11. Data

files were converted to the Update 11 format. Using Update 11 to execute the P-level 4 analysis yielded negative pivots in matrices which caused the analysis to abort after generating a cost of $3,647.39 prior to obtaining results. Possible errors indicated in the error diagnostic message were checked and none found. The line containing the value of P-level was changed from 4 to 1 and the P-level 1 analysis was performed for debugging. The P-level 1 analysis executed with no negative pivots. MCAUTO FIESTA support people could not explain why negative pivots emerged for the P-level 4 analysis and not in the P-level 1 analysis nor could they offer any means of correcting this. P-level 2 was analyzed using Update 11 to compare with the results using Update 8. Although results were obtained, three negative pivots were detected which caused bogus displacement and stress values resulting from an imbalance between the applied loads and the reactions. The summation of the applied loads and reactions were off by a factor of 10^7.

81. At this point attempts for a P-level 4 analysis were abandoned and a P-level 3 analysis was attempted. Since P-level 2 and P-level 4 analyses did not work properly with Update 11, Update 8 was used. Data files were converted to the Update 8 format and the execution procedure was modified to access Update 8. Results of a higher level (P-level 3) were finally obtained for comparison with P-level 2 results.

Comparison

82. GTSTRUDL was much easier to execute. The time involved in the unproductive attempts at a P-level 4 analysis was 20 man hours and was not included in the discussion of cost in paragraph 84.

Results

83. Displacements and stresses for the nodes shown in Figure 37 were used for comparison. These points were selected because the intersection of the stem and base is a critical area, yet the points are far enough away from singularities (stress concentrations) to give reliable results. Results of FIESTA P-levels 2 and 3 along with those from GTSTRUDL are shown in Table 7. Results of both FIESTA analyses are close and compare favorably with GTSTRUDL results. Ideally, the results should be identical but differing approximations of geometry, loads, and element behavior account for the differences. A plot for the FIESTA analyses of the potential energy versus the inverse of the

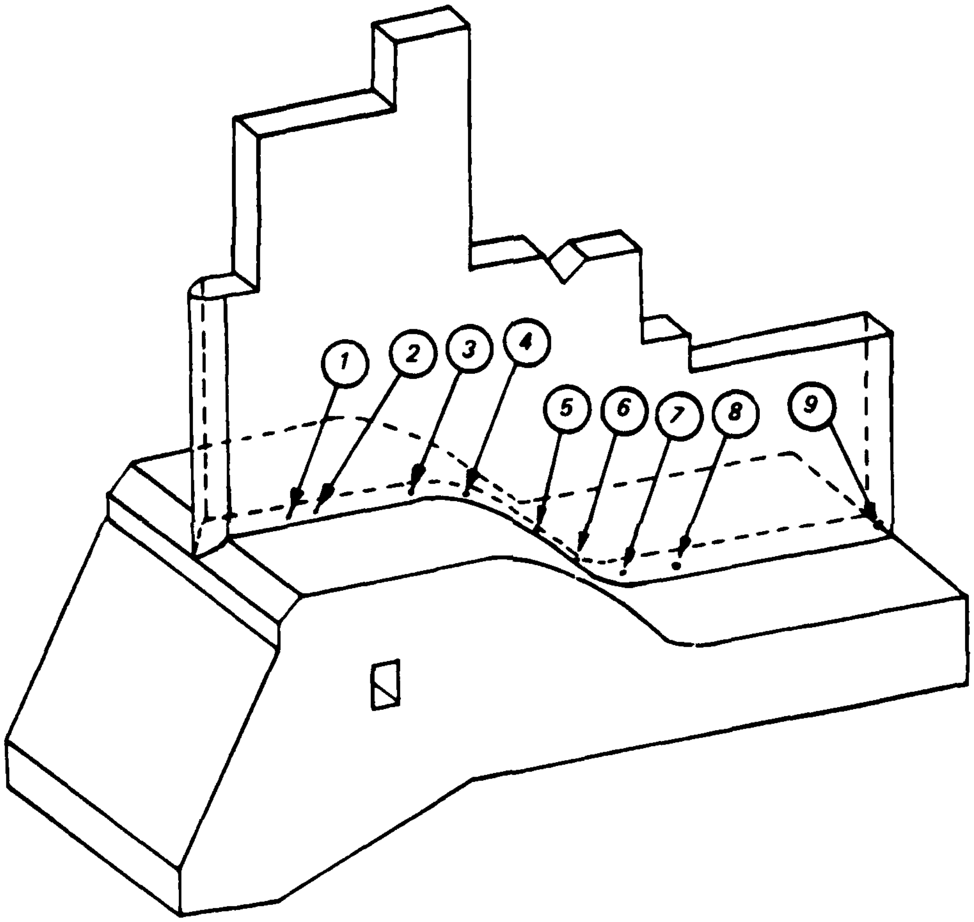

Figure 37. Location of comparison nodes

Table 7

Selected Results of Analysis

Code	δX, ft	δY, ft	δZ, ft	σX, psf	σY, psf	σZ, psf
			P-Level 1			
FIESTA 2	0.0003376	-0.0006346	0.0000020	-3,496.6	-6,375.7	-3,323.7
FIESTA 3	0.0003428	-0.0006372	0.0000013	-3,154.0	-6,854.9	-3,274.5
GTSTRUDL	0.0001644	-0.0006490	0.0000003	-1,483.2	-6,839.1	-2,888.6
			P-Level 2			
FIESTA 2	0.0003232	-0.0006148	-0.0000023	-2,557.2	-6,308.5	-3,166.6
FIESTA 3	0.0003275	-0.0006147	-0.0000031	-3,107.6	-6,658.8	-3,192.6
GTSTRUDL	0.0001645	-0.0006170	-0.0000022	-1,777.5	-6,913.4	-2,789.5
			P-Level 3			
FIESTA 2	0.0002913	-0.0005196	-0.0000003	-1,723.7	-5,394.7	-2,588.6
FIESTA 3	0.0002922	-0.0005202	-0.0000020	-1,810.4	-5,883.3	-2,396.4
GTSTRUDL	0.0001709	-0.0005000	-0.0000009	-745.4	-5,877.3	-1,781.0
			P-Level 4			
FIESTA 2	0.0002591	-0.0004654	-0.0000219	-1,215.4	-5,253.4	-1,639.6
FIESTA 3	0.0002589	-0.0004662	-0.0000249	-1,240.1	-5,593.2	-1,453.2
GTSTRUDL	0.0001578	-0.0004463	-0.0000203	-963.8	-4,785.2	-1,440.6
			P-Level 5			
FIESTA 2	0.0001412	-0.0003583	-0.0000344	-1,257.3	-6,014.0	-1,232.5
FIESTA 3	0.0001414	-0.0003598	-0.0000393	-1,[illegible]21.7	-6,211.4	-1,213.4
GTSTRUDL	0.0000832	-0.0003340	-0.0000317	-1,[illegible]29.8	-5,218.8	-1,170.9
			P-Level 6			
FIESTA 2	0.0000770	-0.0002573	-0.0000205	-1,475.4	-6,982.9	-1,885.1
FIESTA 3	0.0000769	-0.0002569	-0.0000211	-1,508.8	-6,986.2	-1,800.6
GTSTRUDL	0.0000449	-0.0002381	-0.0000162	-1,320.3	-6,075.0	-1,435.1
			P-Level 7			
FIESTA 2	0.0000625	-0.0002239	-0.0000283	-1,409.5	-7,394.2	-2,451.7
FIESTA 3	0.0000629	-0.0002231	-0.0000312	-1,381.0	-7,360.2	-2,263.1
GTSTRUDL	0.0000379	-0.0002024	-0.0000215	-1,[illegible]54.1	-6,406.9	-1,768.3
			P-Level 8			
FIESTA 2	0.0000661	-0.0002233	-0.0000505	-1,683.2	-7,387.6	-2,590.4
FIESTA 3	0.0000669	-0.0002224	-0.0000546	-1,6[illegible]5.7	-7,352.6	-2,440.2
GTSTRUDL	0.0000429	-0.0001999	-0.0000424	[illegible]	-6,379.6	-1,854.4
			P-Level 9			
FIESTA 2	[illegible]	[illegible]	-0.0001006	[illegible]	-6,923.6	-2,251.3
FIESTA 3	0.0000921	[illegible]	-0.0001058	-939.5	-7,082.6	[illegible]
GTSTRUDL	0.0000706	[illegible]	-0.0000819	[illegible]	[illegible]	-1,350.8

active DoF is shown in Figure 38. Using procedures shown in the FIESTA manuals, the errors of solution for the energy norm were 8.9 percent and 15.2 percent for P-level 2 and P-level 3, respectively. This is a measure of error in the total (average) solution. The error at individual nodes may be more or less dependent on mesh refinement and proximity to singularities. GTSTRUDL analysis was done for only one grid. Other grids should be analyzed to guarantee solution convergence.

Cost Comparison

84. The computer costs for FIESTA were $412.70 for P-level 2 and $1,004.32 for P-level 3. The GTSTRUDL computer cost was $63.86. It took 120 man hours to prepare for the P-level 2 analysis and 150 man hours for the GTSTRUDL analysis. It would be reasonable to assume 150 man hours for each grid refinement done for GTSTRUDL while it took less than one man hour of work for the P-level 3 analysis.

Conclusions

85. FIESTA is a new code that, unlike GTSTRUDL, has not withstood the test of time. Consequently, many of the problems encountered were due to this immaturity. However, FIESTA is well suited for 3-D analyses and gives good results. Use of this program should not relieve engineers of their responsibility to analyze results for their correctness. Errors in the user's manual should be corrected and addition of the suggested capabilities would greatly enhance the use of FIESTA.

86. FIESTA's capabilities of increasing DoF and contouring plots of output makes this program desirable for 3-D FE work. As seen from the cost figures, the cost of manpower far exceeds the computer cost. The ability to conduct a mesh convergence study of the complex 3-D problems in a minimum of 150 man hours without generating new grid results is demonstrated in this report.

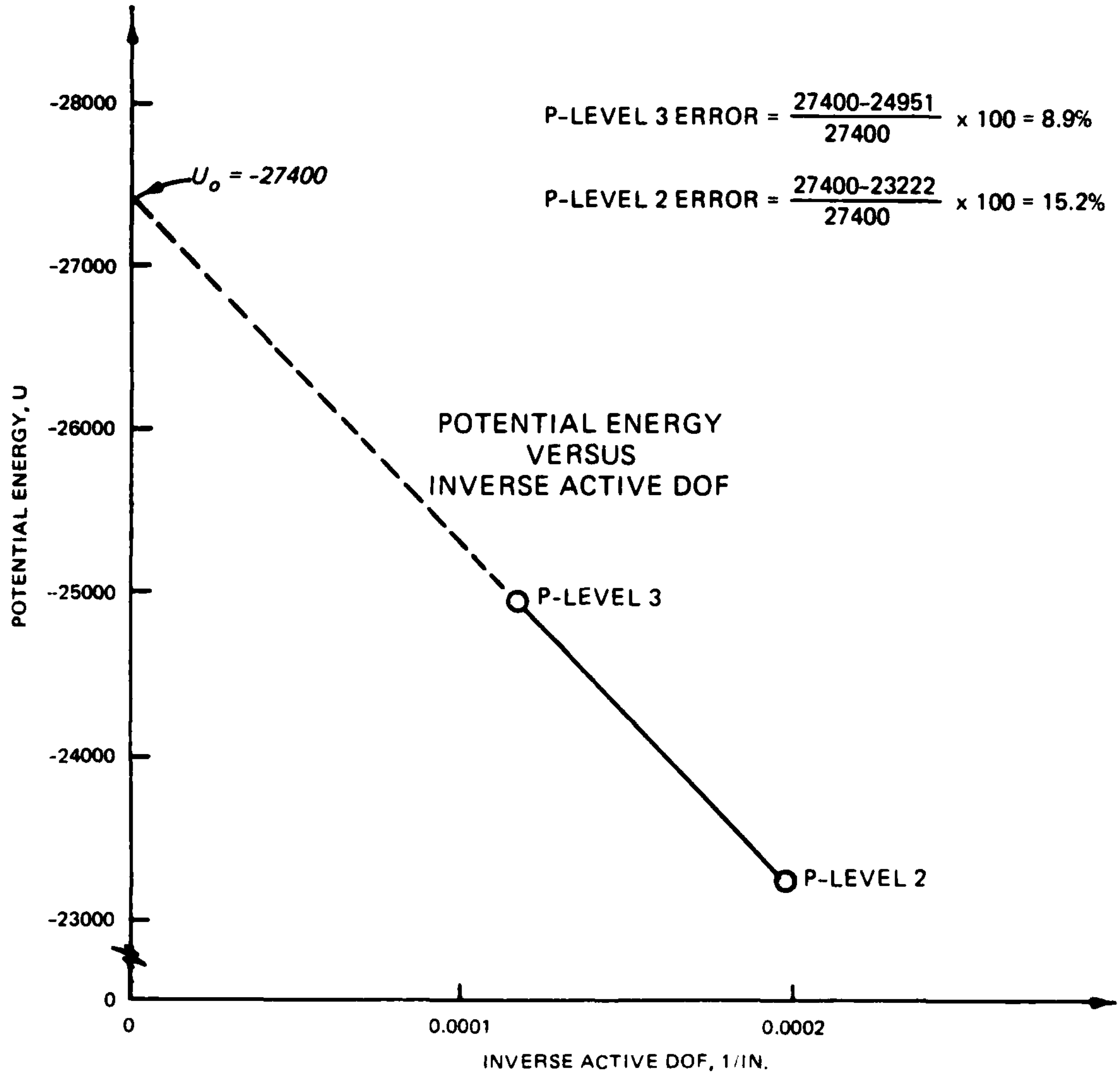

Figure 38. Node displacements and stresses shown for comparison

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APPENDIX A: FIESTA FILE AND PLOTS FOR COARSE GRID, TWO-DIMENSIONAL DAM

```
TDCP6        14:11 JUL 16,'84

$TOP
COARSE 2-D DAM PROBLEM
1 -11.92 0 1
2 0 0 1
3 131.33 0 1
4 0 5 1
5 5 5 1
6 -10.83 13 1
7 0 13 1
8 5 13 1
9 93 46 1
10 0 143 1
11 17 160 1
12 0 185 1
13 17 185 1
14 -11.92 0 0
15 0 0 0
16 131.33 0 0
17 0 5 0
18 5 5 0
19 -10.83 13 0
20 0 13 0
21 5 13 0
22 93 46 0
23 0 143 0
24 17 160 0
25 0 185 0
26 17 185 0
END OF COORDINATES
31 1 14 15 18 17 1 2 5 4
21 2 15 16 18 2 3 5
31 3 14 17 20 19 1 4 7 6
31 4 17 18 21 20 4 5 8 7
21 5 18 22 21 5 9 8
21 6 19 20 23 6 7 10
31 7 20 21 24 23 7 8 11 10
21 8 21 22 24 8 9 11
31 9 23 24 26 25 10 11 13 12
21 10 18 16 22 5 3 9
END OF INCIDENCES
NO LOCAL COOR. SYS
4
NO EQUIVALETING
0
$CHECK
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
0. 0. 90.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT
END OF PLOT DATA
$CONST
3 0 3
1 2
3 0 1 2 3
3
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E8 .33
4.658 6.E-6
END OF MATERIAL PROPERTIES
$PLEVEL
6
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
GRAVITY LOAD IN -Y
3
0 -32.2 0 0
ALL
END OF LOAD CASE 1
2
HYDROSTATIC LOAD IN +X
5
2 62.4 143 2 0
13 24
END OF HYDROSTATIC LOAD
END OF LOAD CASE 2
END OF LOADS
$LCOMB
10
LOAD COMBINATION 1
1 1 2 1
END OF LOAD COMBINATION 1
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$AXES
10 0 0
-11.92 0 0 0
END OF LOCAL AXES SYSTEM-10
$CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
$CDATA
100 10 0 1 0 1
HYDROSTATIC + DEAD LOAD , PLEVEL = 6
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0 0 .5
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure A1. Data file for analysis and plotting of coarse grid two-dimensional (2-D) dam

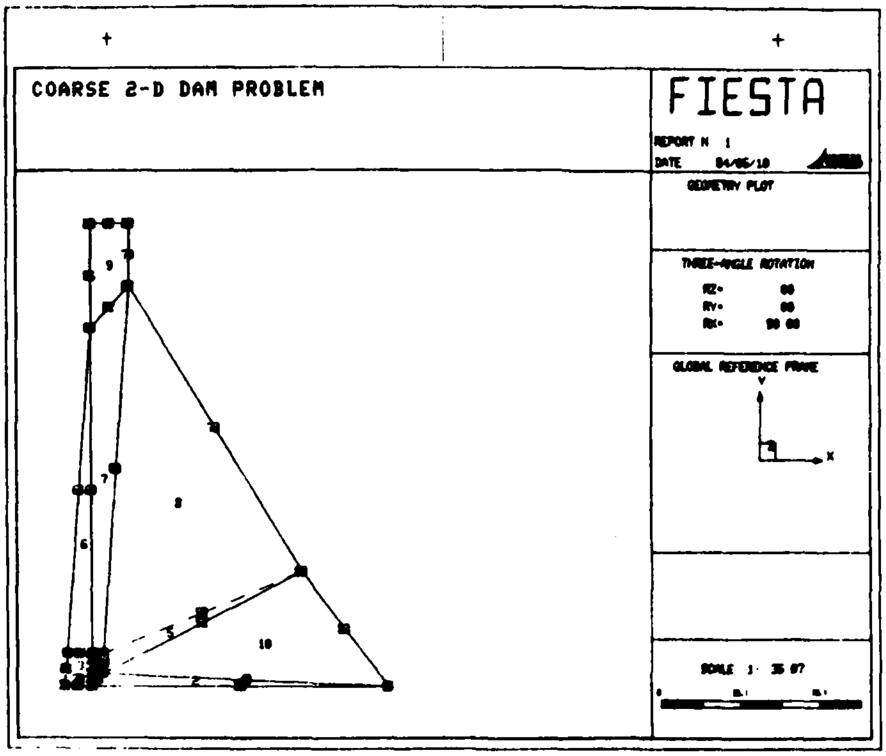


Figure A2. Plot of nodes and elements

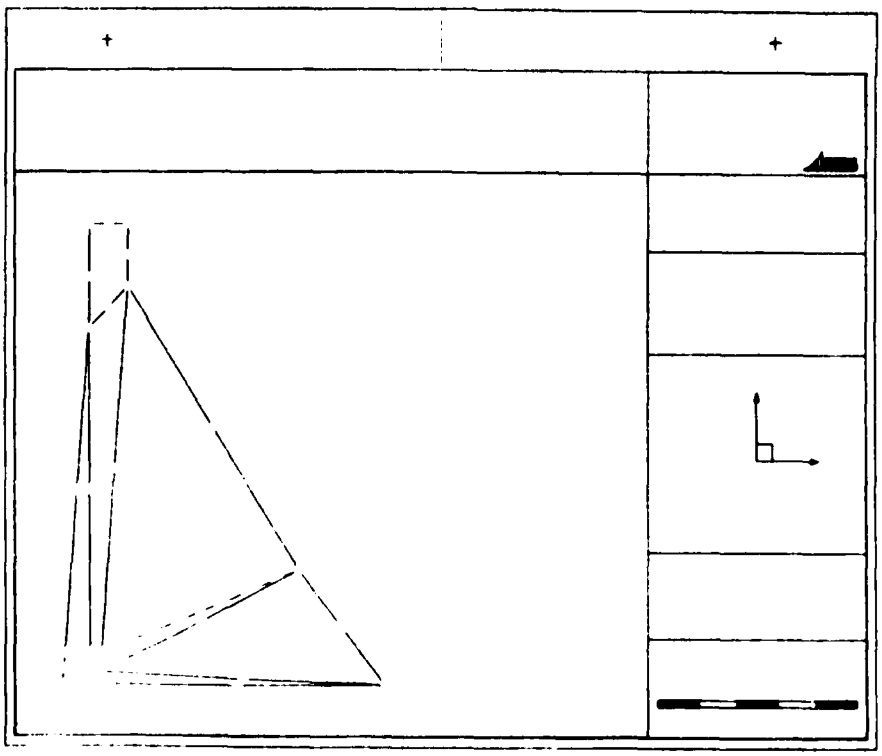


Figure A3. Plot of grid

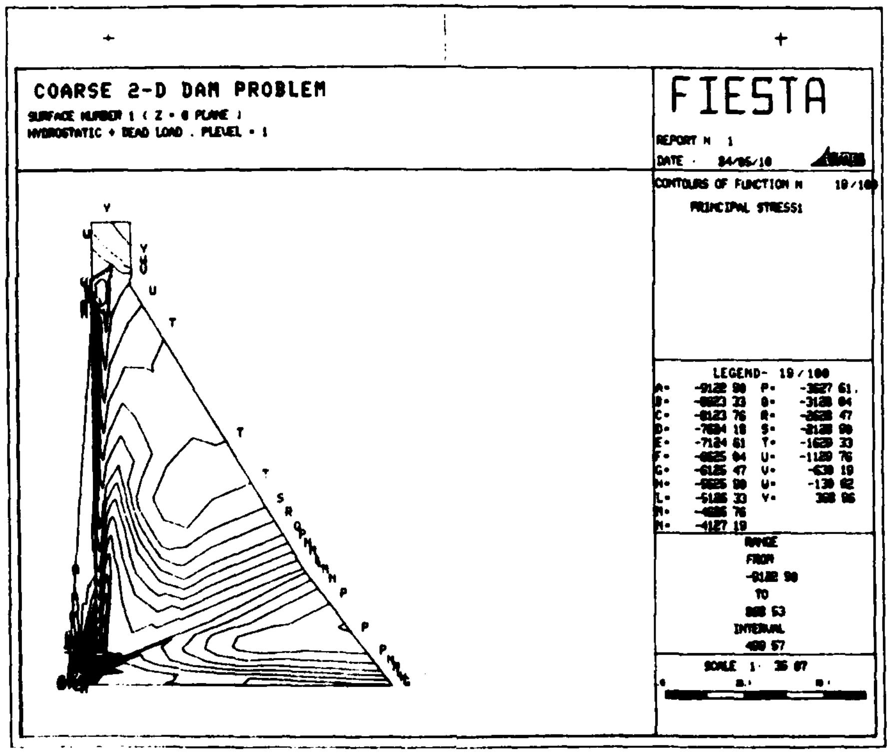


Figure A4. Annotated contour plot of principal stresses in X direction, P-level 1

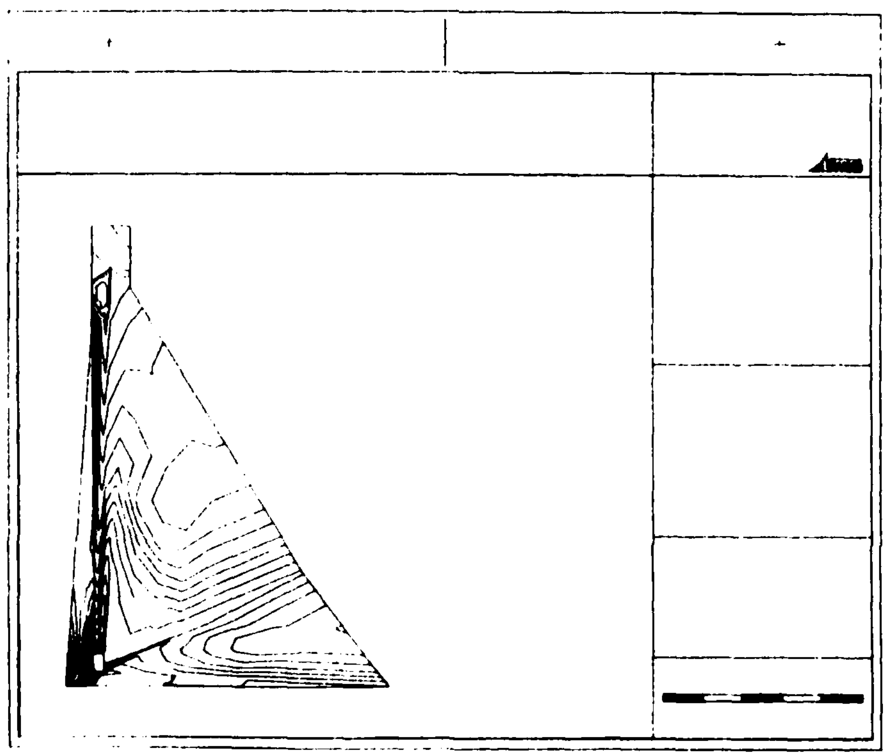


Figure A5. Nonannotated contour plot of principal stresses in X direction, P-level 1.

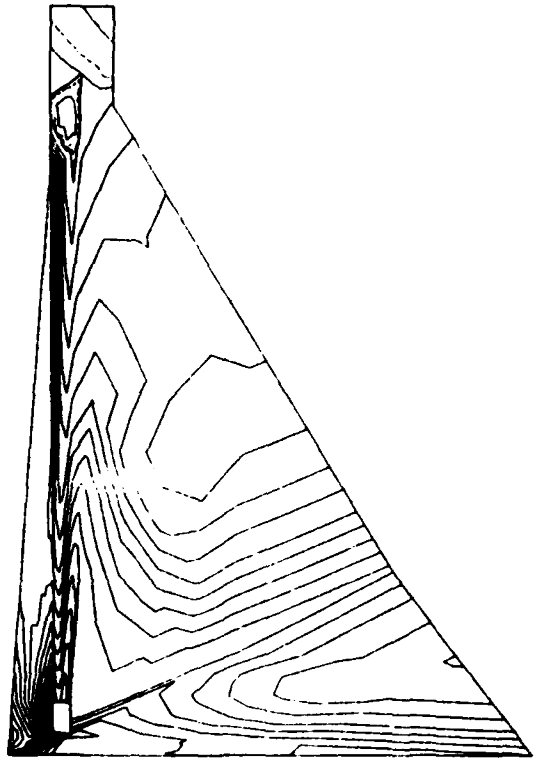


Figure A6. Nonannotated contour plot without boundary, X-direction principal stresses, P-level 1

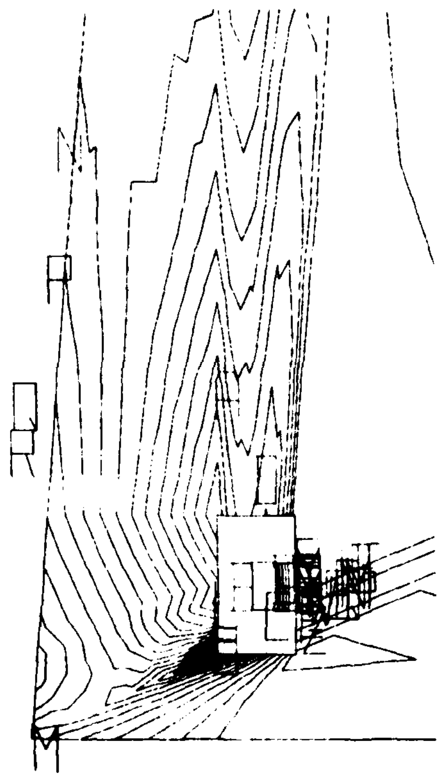


Figure A7. Window plot of annotated contour plot, X-direction principal stresses, P-level 1

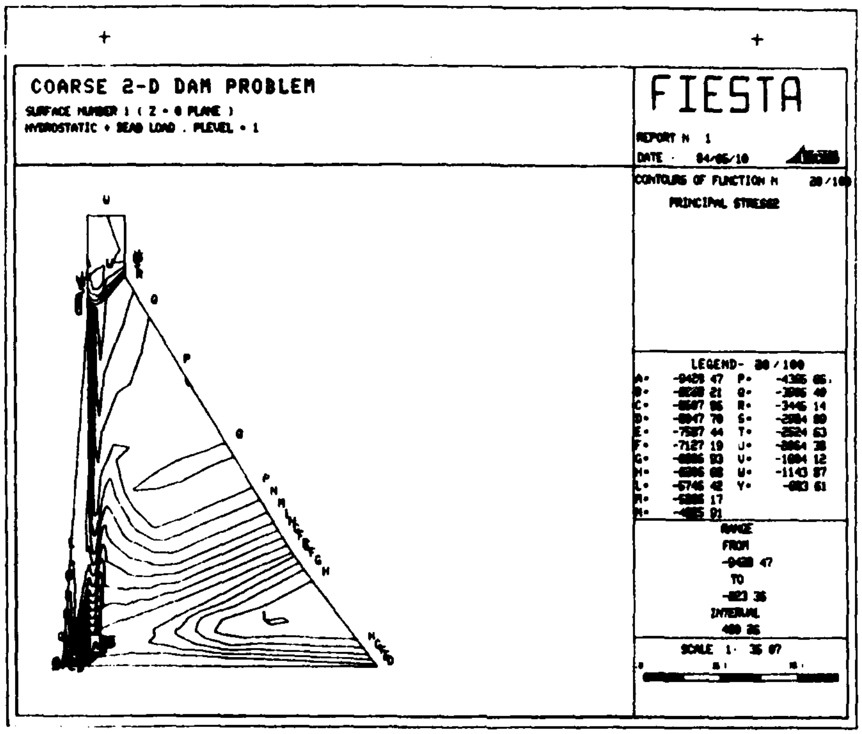


Figure A8. Annotated contour plot of principal stresses in Y-direction, coarse grid, P-level 1

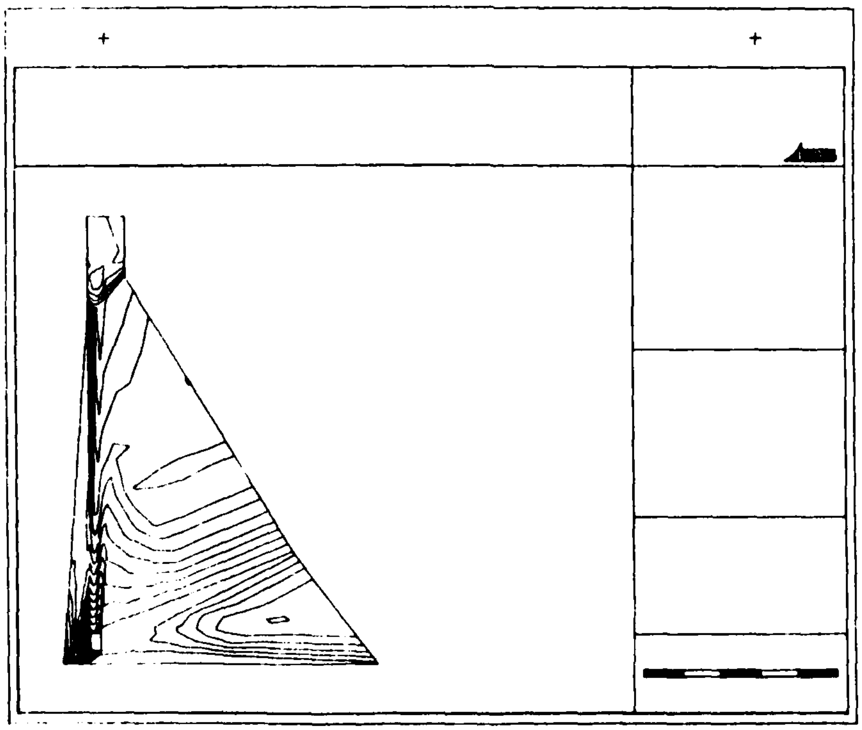


Figure A9. Nonannotated contour plot of stresses in Y-direction, coarse grid, P-level 1

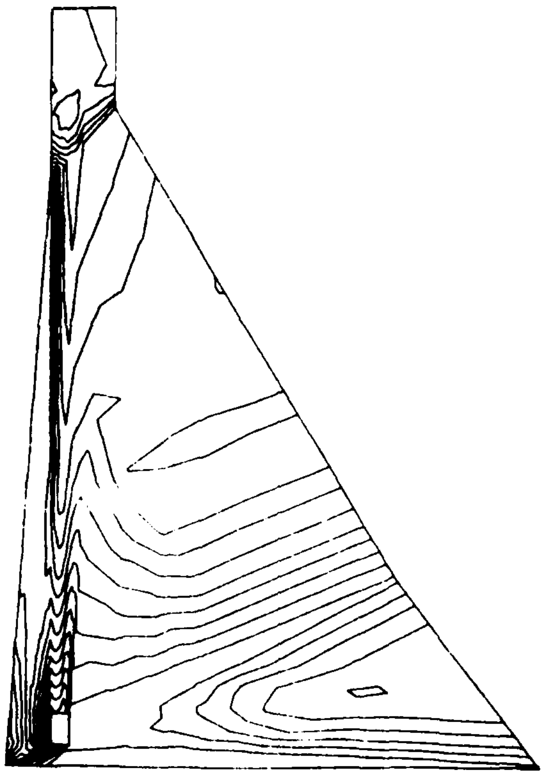


Figure A10. Nonannotated contour plot, Y-direction stress without boundary, coarse grid, P-level 1

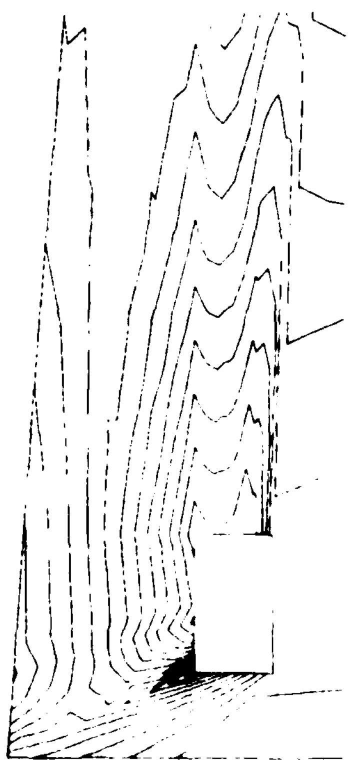


Figure A11. Window plot of nonannotated, Y-direction stress contours, coarse grid, P-level 1

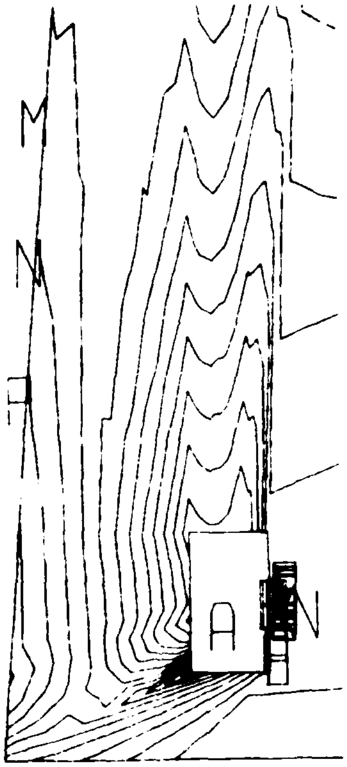


Figure A12. Window plot of annotated, Y-direction stress contours, coarse grid, P-level 1

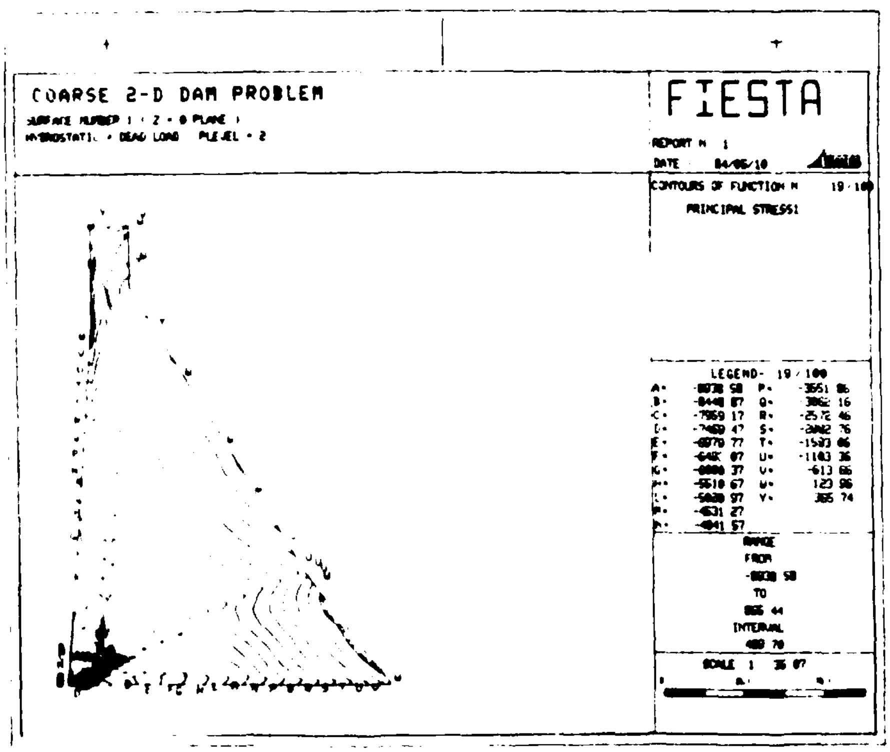


Figure A13. Annotated contour plot of X-direction principal stresses, coarse grid, P-level 2

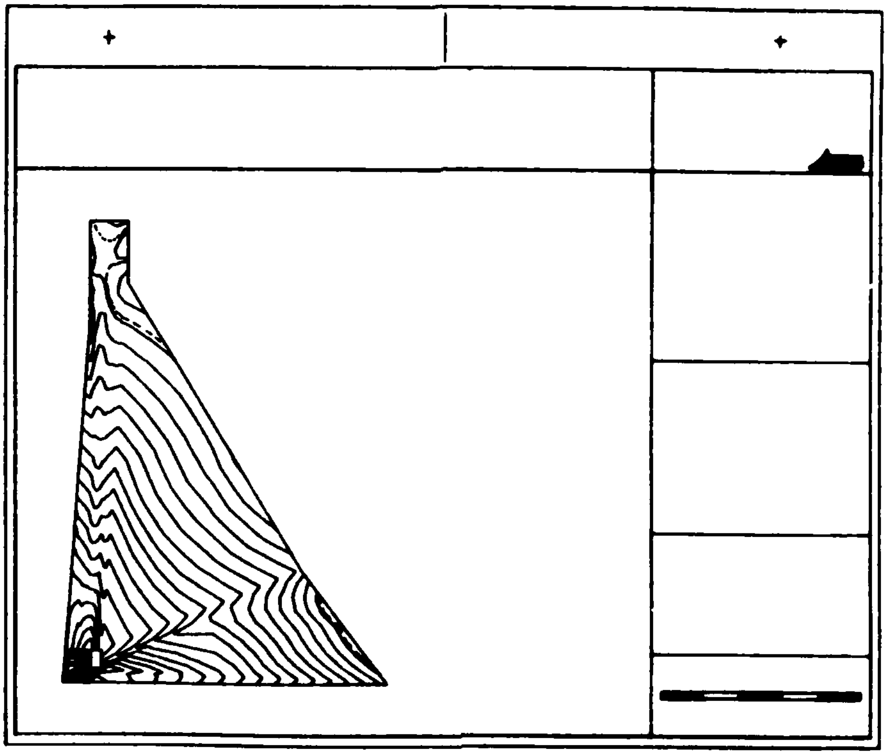


Figure A14. Nonannotated contour plot of X-direction principal stresses, coarse grid, P-level 2

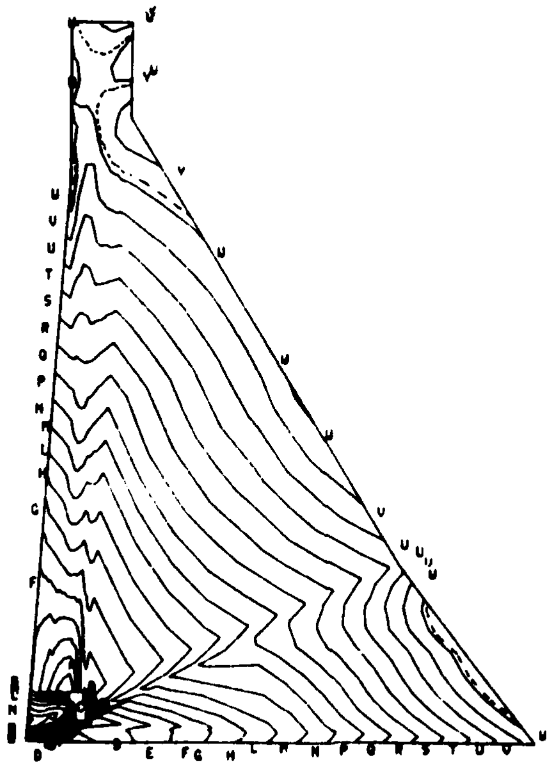


Figure A15. Window plot of annotated X-direction principal stress contours, coarse grid, P-level 2

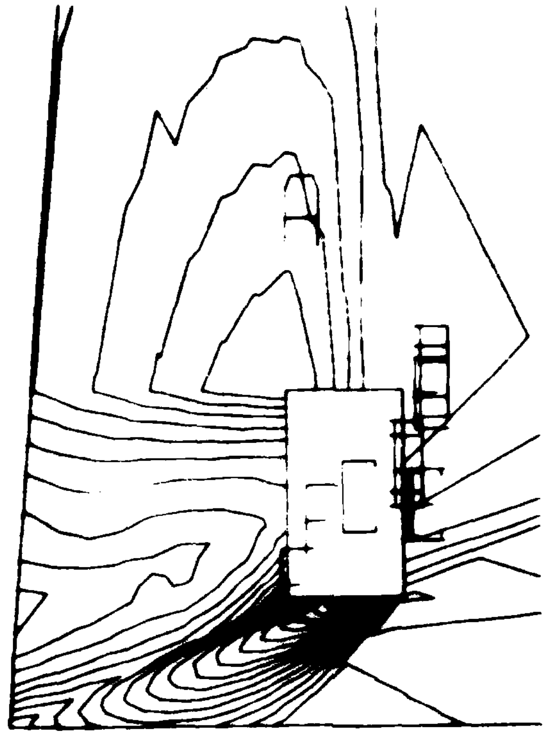


Figure A16. Subwindow plot of annotated X-direction principal stress contours, coarse grid, P-level 2

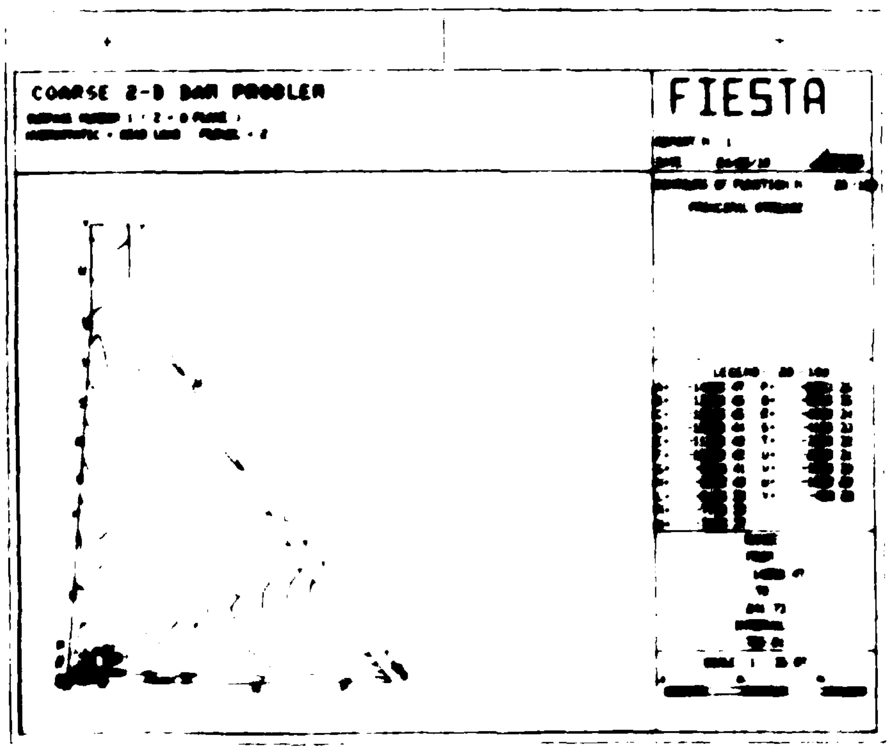


Figure A17. Annotated plot of Y-direction principal stress contours, coarse grid, P-level 2

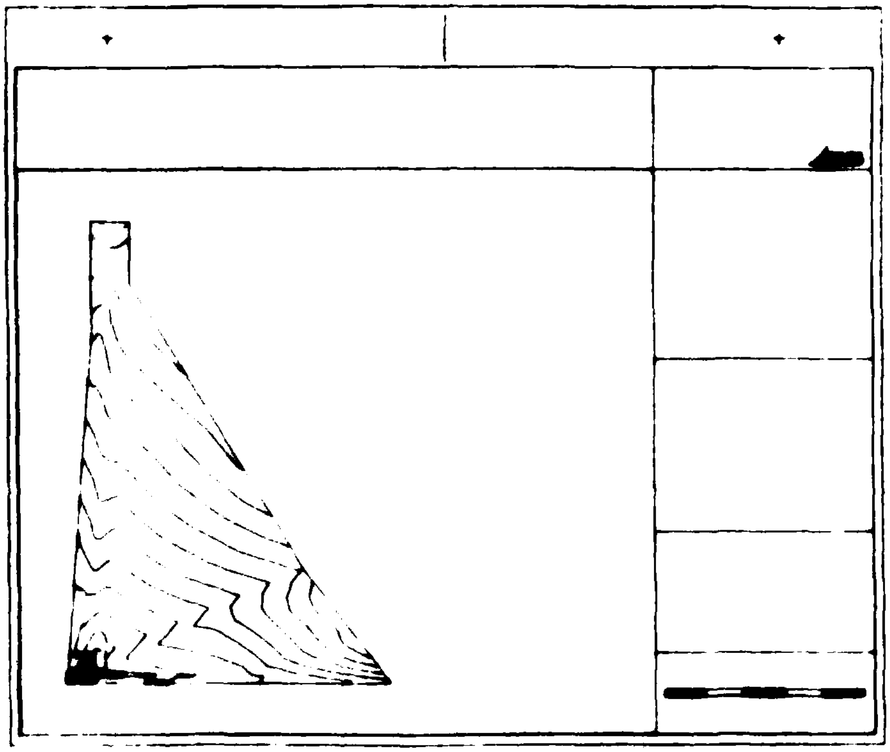


Figure A18. Nonannotated plot of Y-direction principal stress contours, coarse grid, P-level 2

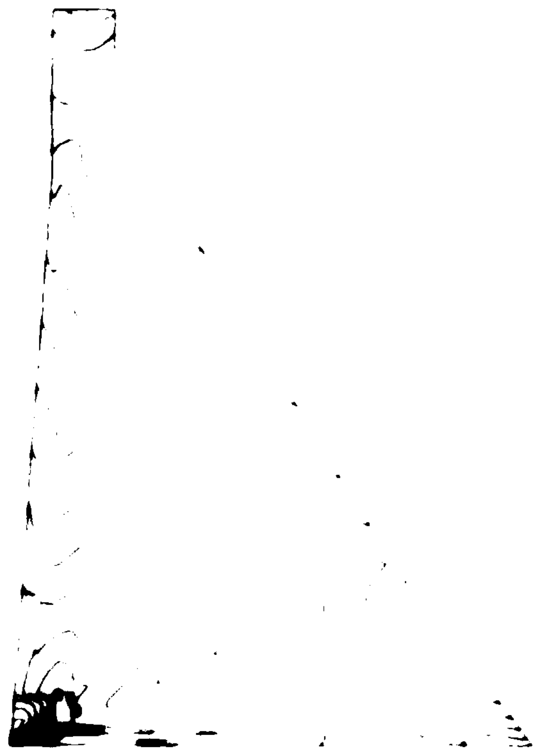


Figure A19. Window plot of partially annotated, Y-direction principal stress contours, coarse grid, P-level 2

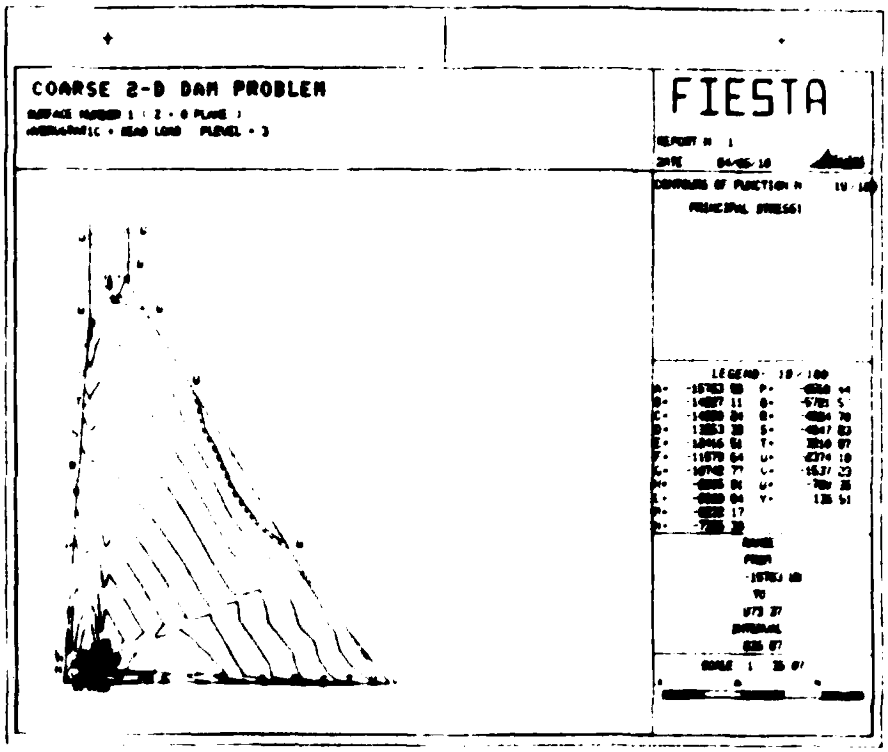


Figure A20. Annotated plot of X-direction principal stress contours, coarse grid, P-level 3

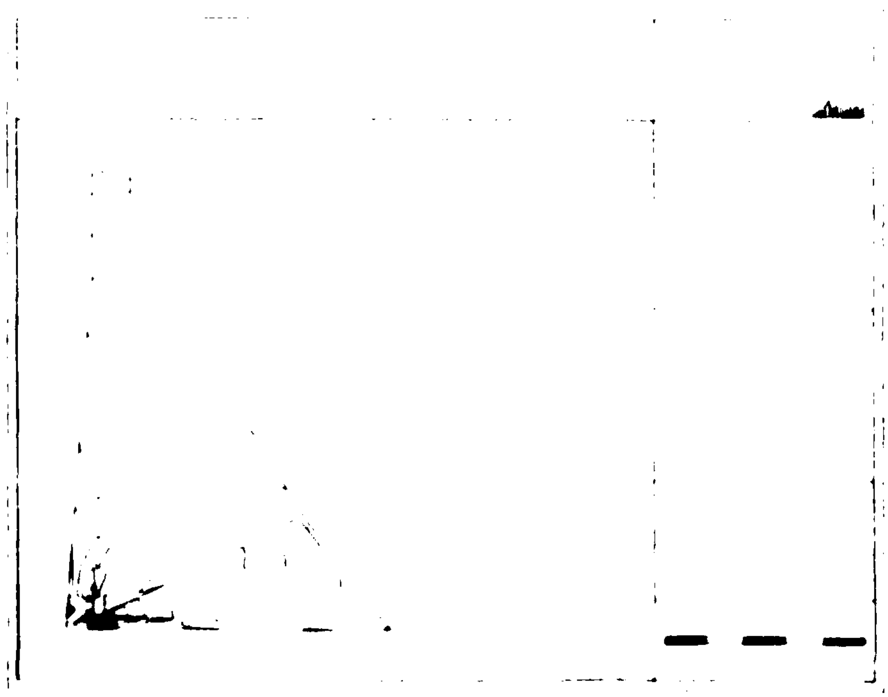


Figure A21. Nonannotated plot of X-direction principal stress contours, coarse grid, P-level 3

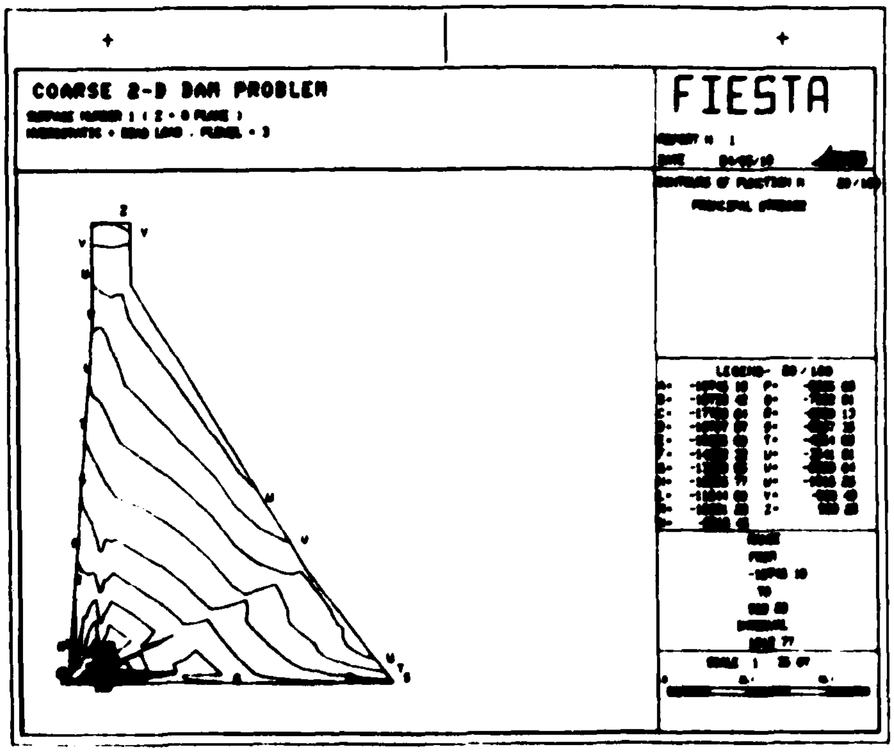


Figure A22. Annotated plot of Y-direction principal stress contours, coarse grid, P-level 3

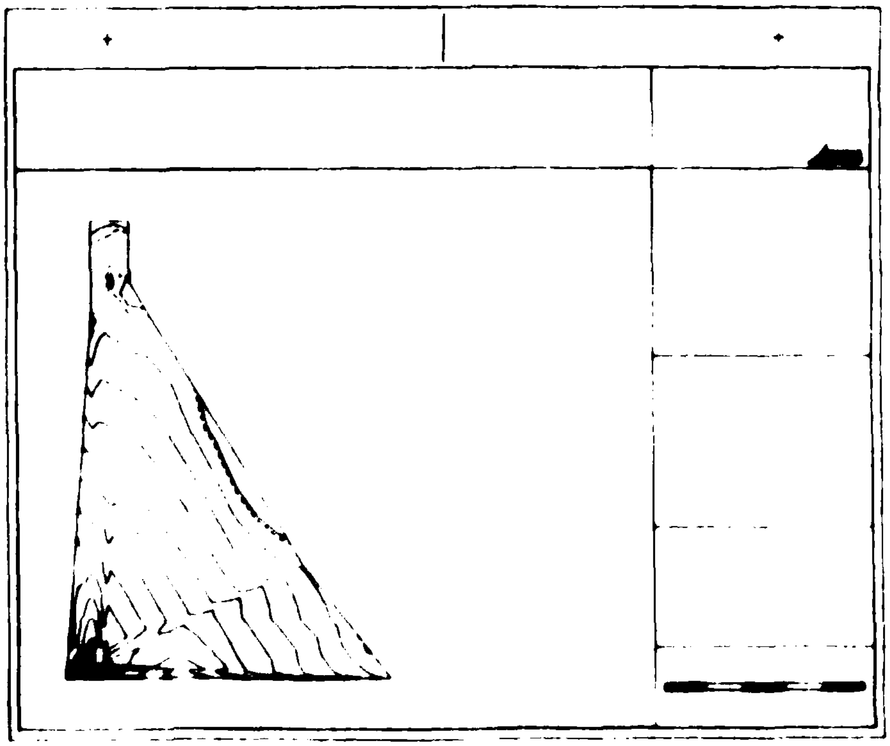


Figure A23. Nonannotated plot of Y-direction principal stress contours, coarse grid, P-level 3

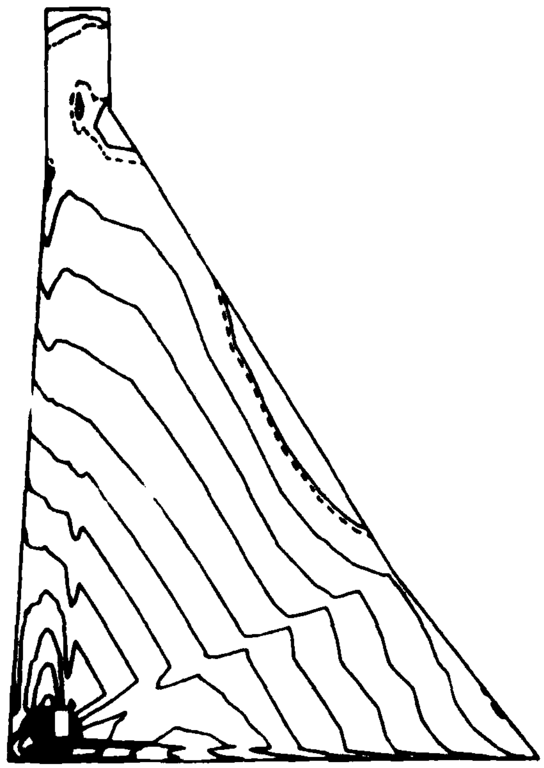


Figure A24. Window plot of nonannotated Y-direction principal stress contours, coarse grid, P-level 3

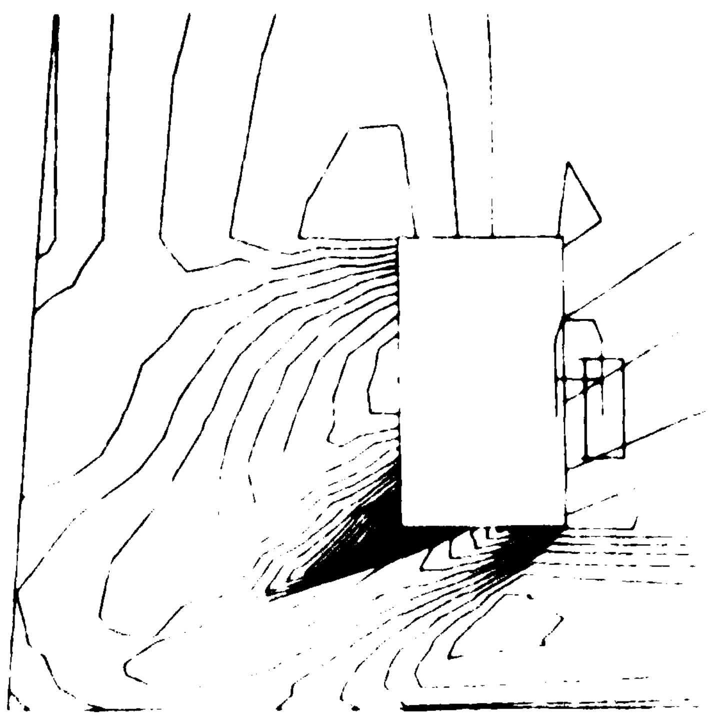


Figure A25. Window plot of partially annotated Y-direction principal stress contours, coarse grid, P-level 3

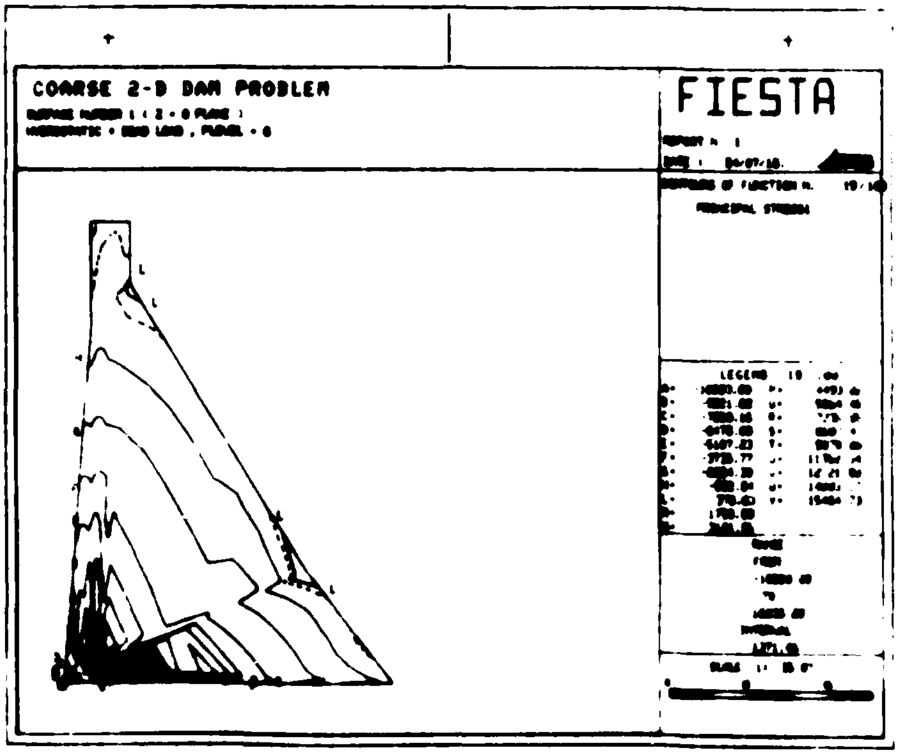


Figure A26. Annotated plot of X-direction principal stress contours, coarse grid, P-level 6

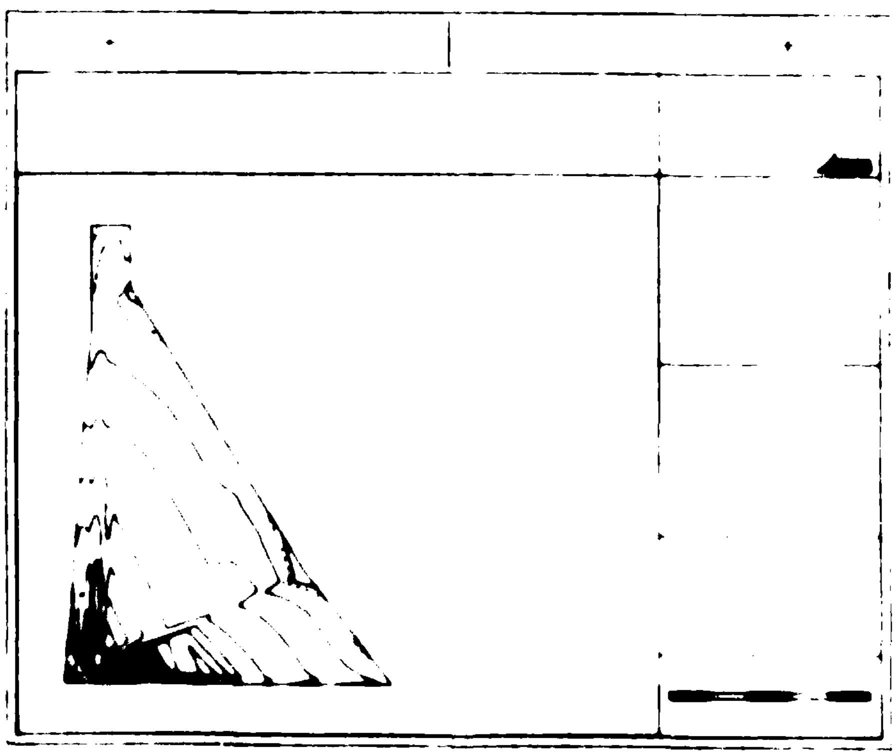


Figure A27. Nonannotated plot of X-direction principal stress contours, coarse grid, P-level 6

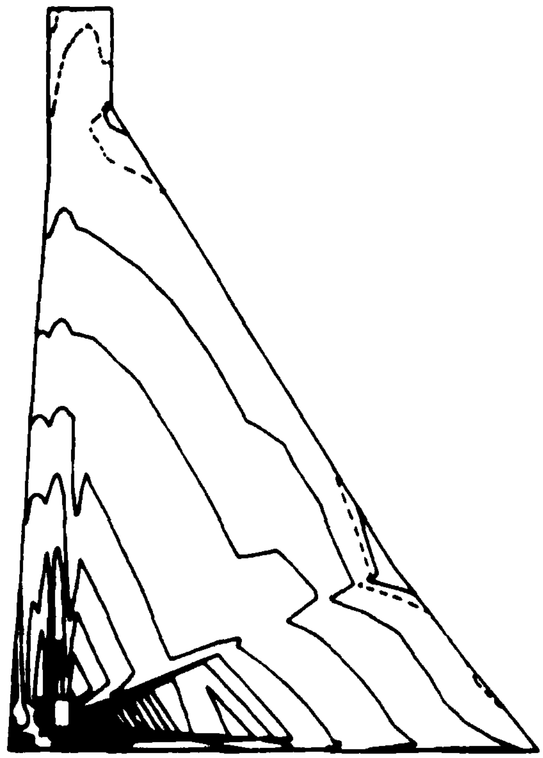


Figure 28. Window plot of nonannotated X-direction principal stress contours, coarse grid, P-level 6

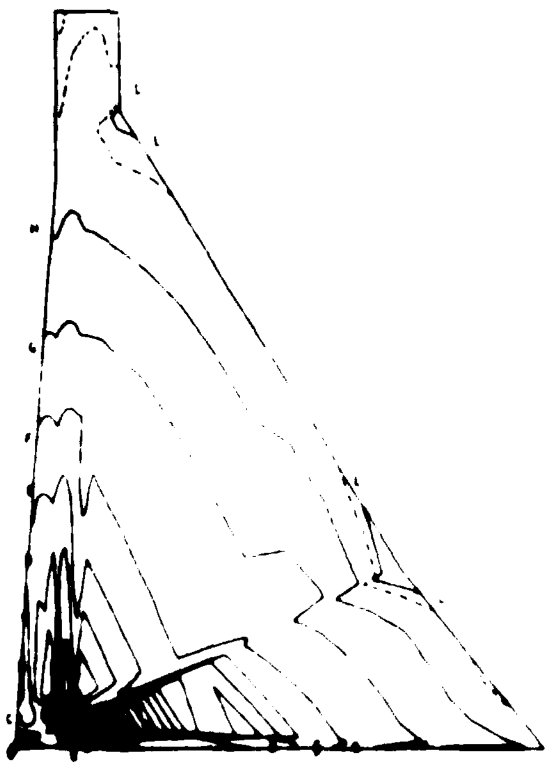


Figure A29. Window plot of annotated X-direction principal stress contours, coarse grid, P-level 6

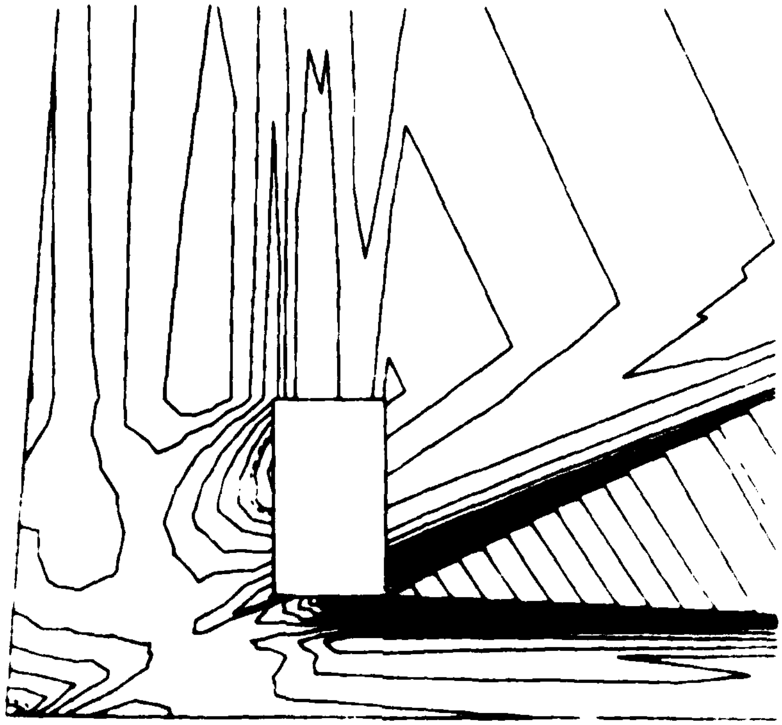


Figure A30. Subwindow plot of nonannotated, X-direction principal stress contours, coarse grid, P-level 6

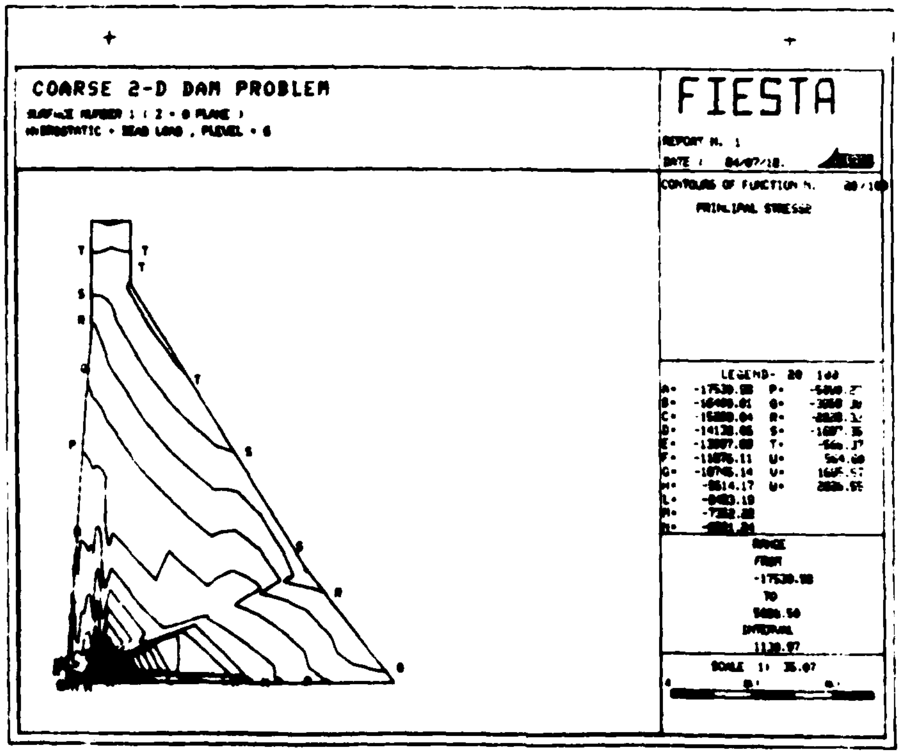


Figure A31. Annotated plot of Y-direction principal stress contours, coarse grid, P-level 6

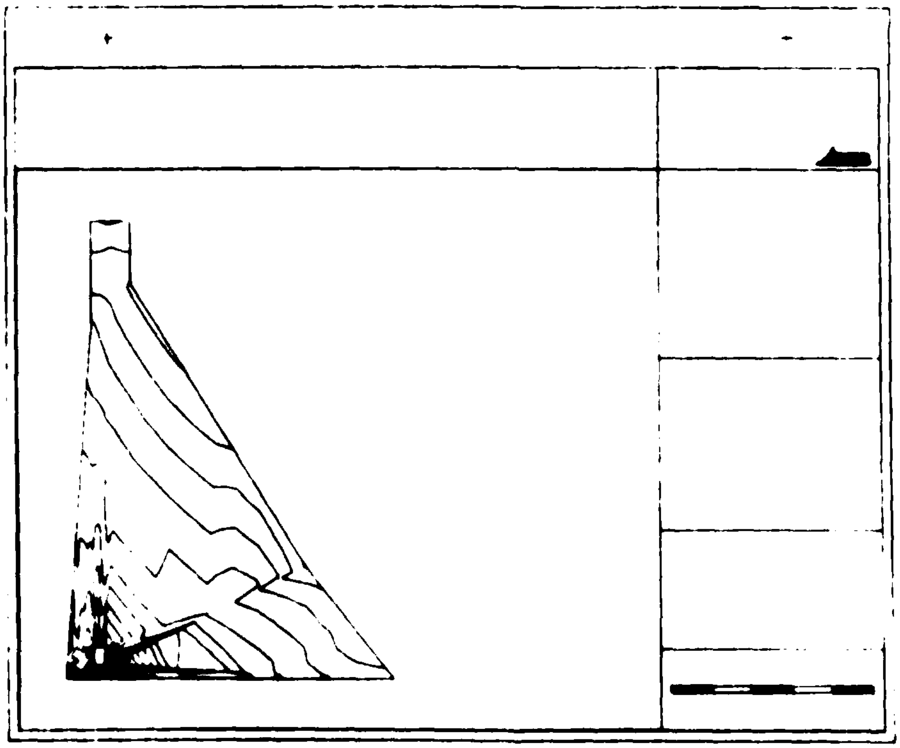


Figure A32. Nonannotated plot of Y-direction principal stress contours, coarse grid, P-level 6

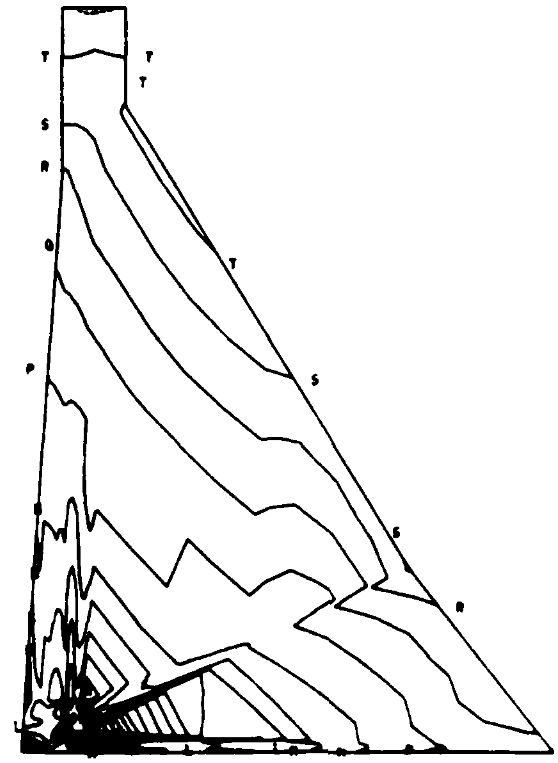


Figure A33. Window plot of annotated, Y-direction principal stress contours, coarse grid, P-level 6

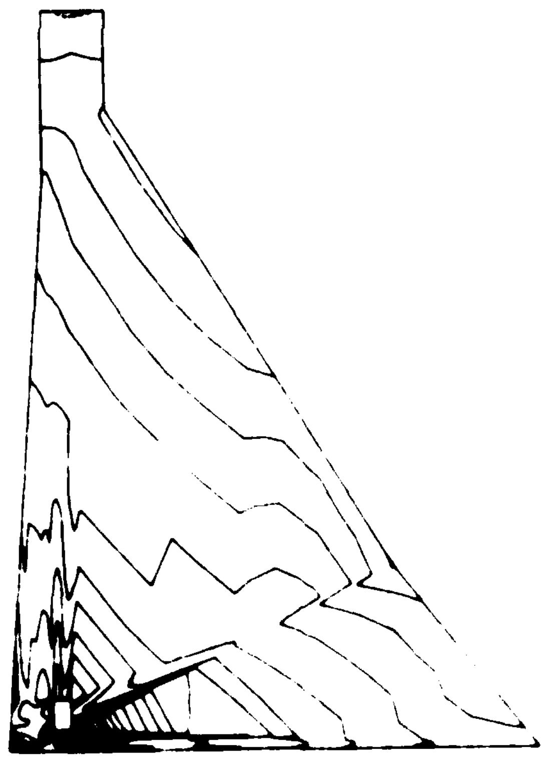


Figure A34. Window plot of nonannotated, Y-direction principal stress contours, coarse grid, P-level [illegible]

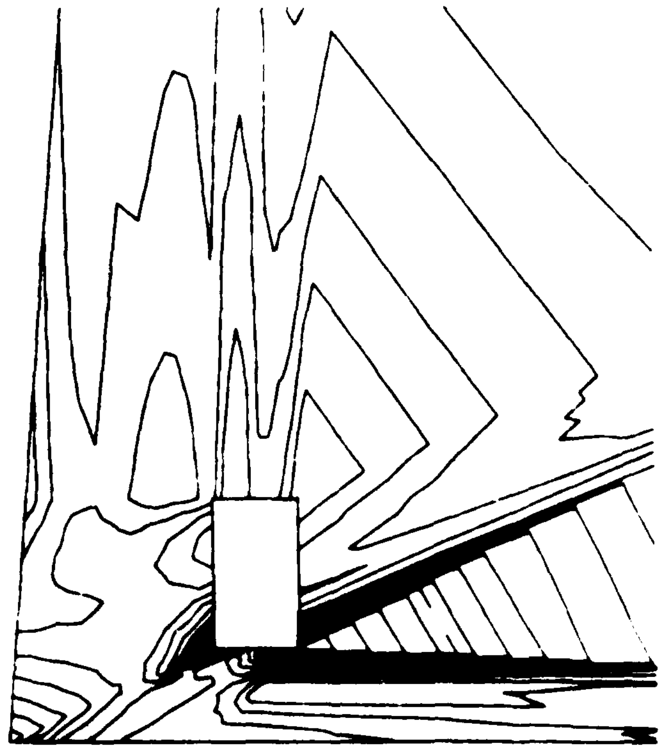


Figure A35. Subwindow plot of nonannotated, Y-direction principal stress contours, coarse grid, P-level 6

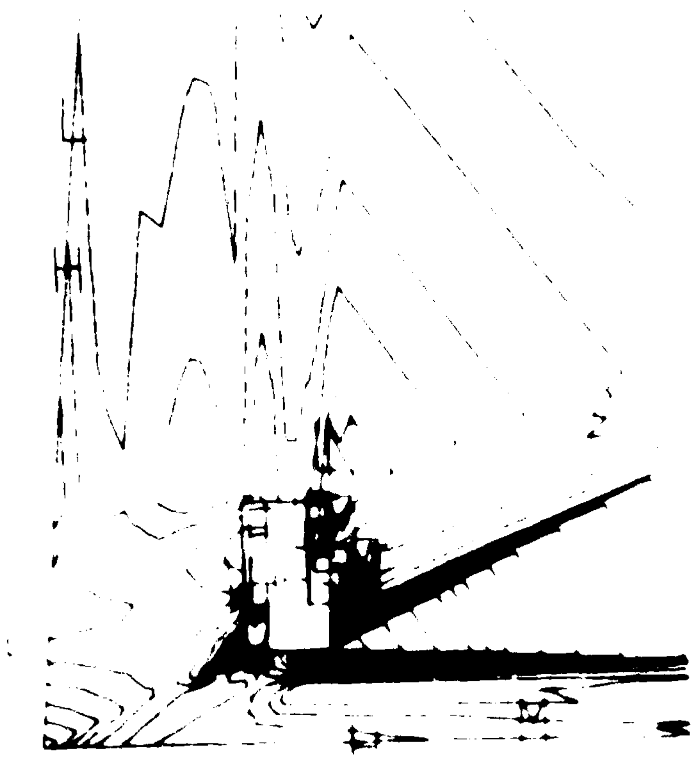


Figure A36. Subwindow plot of annotated, Y-direction principal stress contours, coarse grid, P-level 6

APPENDIX B: FIESTA FILE AND PLOTS FOR FINE GRID, TWO-DIMENSIONAL DAM

```
TEPS      14:12 JUL 16,'84

00100 STOP
00110 2-D DAM PROBLEM
00120 1 -11.88 0 1
00130 2 0 0 1
00140 3 5 0 1
00150 4 88.38 0 1
00160 5 88 0 1
00170 6 131.38 0 1
00180 7 -11.88 5 1
00190 8 0 5 1
00200 9 5 5 1
00210 10 88.38 5 1
00220 11 88 5 1
00230 12 127.16 5 1
00240 13 -10.83 13 1
00250 14 0 13 1
00260 15 5 13 1
00270 16 28.33 13 1
00280 17 93 13 1
00290 18 140.5 13 1
00300 19 -8.83 25 1
00310 20 0 25 1
00320 21 10 25 1
00330 22 28.33 25 1
00340 23 93 25 1
00350 24 110.5 25 1
00360 25 -8.333 46 1
00370 26 0 46 1
00380 27 28.33 46 1
00390 28 93 46 1
00400 29 -4 95 1
00410 30 0 95 1
00420 31 28.33 95 1
00430 32 80.33 95 1
00440 33 0 143 1
00450 34 85.33 143 1
00460 35 0 160 1
00470 36 17 160 1
00480 37 0 185 1
00490 38 17 185 1
00500 39 -11.88 0 0
00510 40 0 0 0
00520 41 5 0 0
00530 42 88.38 0 0
00540 43 88 0 0
00550 44 131.38 0 0
00560 45 -11.88 5 0
00570 46 0 5 0
00580 47 5 5 0
00590 48 88.38 5 0
00600 49 88 5 0
00610 50 147.16 5 0
00620 51 -10.83 13 0
00630 52 0 13 0
00640 53 5 13 0
00650 54 28.33 13 0
00660 55 93 13 0
00670 56 140.5 13 0
00680 57 -8.83 25 0
00690 58 0 25 0
00700 59 10 25 0
00710 60 28.33 25 0
00720 61 93 25 0
00730 62 110.5 25 0
00740 63 -8.33 46 0
00750 64 0 46 0
00760 65 28.33 46 0
00770 66 93 46 0
00780 67 -4 95 0
00790 68 0 95 0
00800 69 28.33 95 0
00810 70 80.33 95 0
00820 71 0 143 0
00830 72 85.33 143 0
00840 73 0 160 0
00850 74 17 160 0
00860 75 0 185 0
00870 76 17 185 0
00880 END OF COORDINATES
00890 31 1 39 40 46 45 1 2 8 7
00900  -1 5 1 1 1 3 6
00910 31 16 57 58 64 63 19 20 26 25
00920 21 17 58 59 64 20 21 26
00930 21 18 59 65 64 21 27 26
00940 21 19 59 60 65 21 22 27
00950 31 20 60 61 66 65 22 23 28 27
00960 21 21 61 62 66 23 24 28
00970 31 22 63 64 68 67 25 26 30 29
00980 -1 3 1
00990 21 25 67 68 71 29 30 33
01000 31 26 68 69 72 71 30 31 34 33
01010 21 27 69 70 72 31 32 34
01020 31 28 71 72 74 73 33 34 36 35
01030 31 29 73 74 76 75 35 36 38 37
01040 END OF INCIDENCES
01050 NO LOCAL CORR. SYSTEM
01060 7
01070 NO EQUIVALENTING
01080 0
01090 $CHECK
01100 $SURF
01110 1
01120 10.
01130 $MPLOT
01140 1
01150 101 5 1 1 1 0 2 0 0 0
01160 0. 0. 90.
01170 END PLOT ID
01180 4
01190 1 101 0 0 0
01200 GEOMETRY PLOT
01210 END OF PLOT DATA
01220 $CONST
01230 3 0 3
01240 1 2
01250 3 0 1 2 3
01260 4
01270 END OF CONST
01280 $PROP
01290 1
01300 ALL
01310 END OF MATERIAL DISP
01320 1 0 0
01330 4.32E8 .33
01340 4.658 6.E-6
```

Figure B1. Data file for analysis and plotting of two-dimensional (2-D) dam fine grid (continued)

```
END OF MATERIAL PROPERTIES
$PLEVEL
5
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
HYDROSTATIC LOAD IN +X
5
8 62.4 143 2 0
3 29 47 89 91 105
END OF HYDROSTACTIC LOAD
END OF LOAD CASE 1
2
GRAVITY LOAD IN -Y
8
0 -32.2 0 0
ALL
END OF LOAD CASE 2
END OF LOADS
$LCOMB
10
LOAD COMBINATION 1
1 1 2 1
END OF LOAD COMBINATION 1
END OF LOAD COMBINATION DEF
$LOVE
[illegible]
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
[illegible]S
10 0 0
-11.[illegible] 0 0 0
[illegible] OF LOCAL AXES SYSTEM-10
[illegible]
1
[illegible] NUMBER 1 ( Z - 0 PLANE )
2 0 1
0. 0. 5.
3
1
[illegible] OF [illegible]
[illegible]
[illegible] 0 1 0 1
[illegible] + [illegible] LOAD , PLEVEL - 5
[illegible] OF [illegible]
[illegible]
1
[illegible] 5 0 7 1 0 1 0. 0.
[illegible]
[illegible]
[illegible]
[illegible] 0 0 0 0 0
[illegible]
[illegible] 0 0 0 0 0
[illegible]
END OF PLOT DATA
$ENDP
$(
```

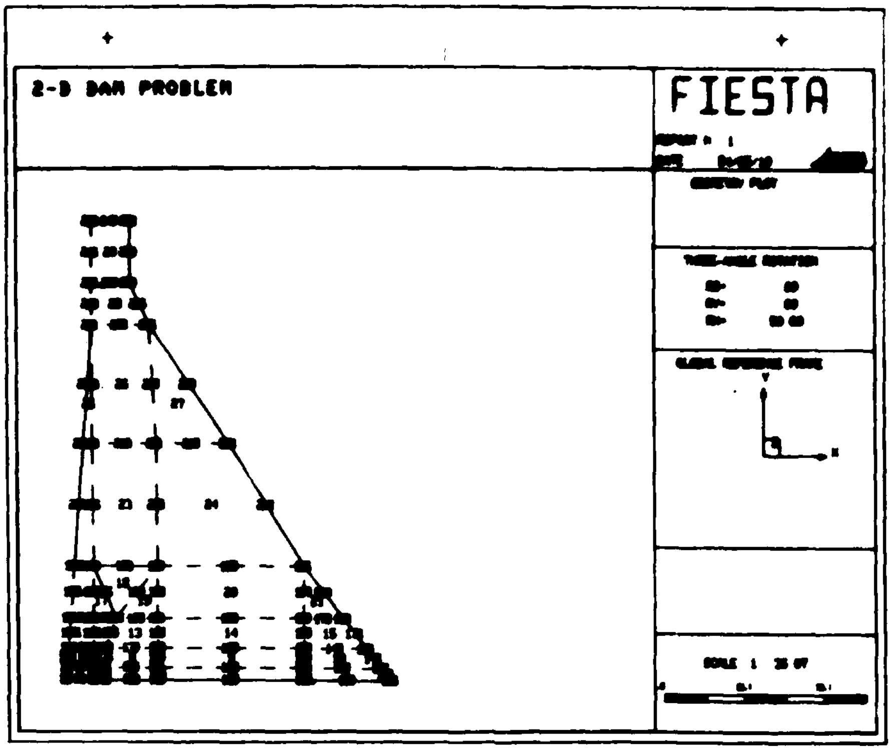


Figure B2. Annotated plot of 2-D dam fine grid nodes and elements

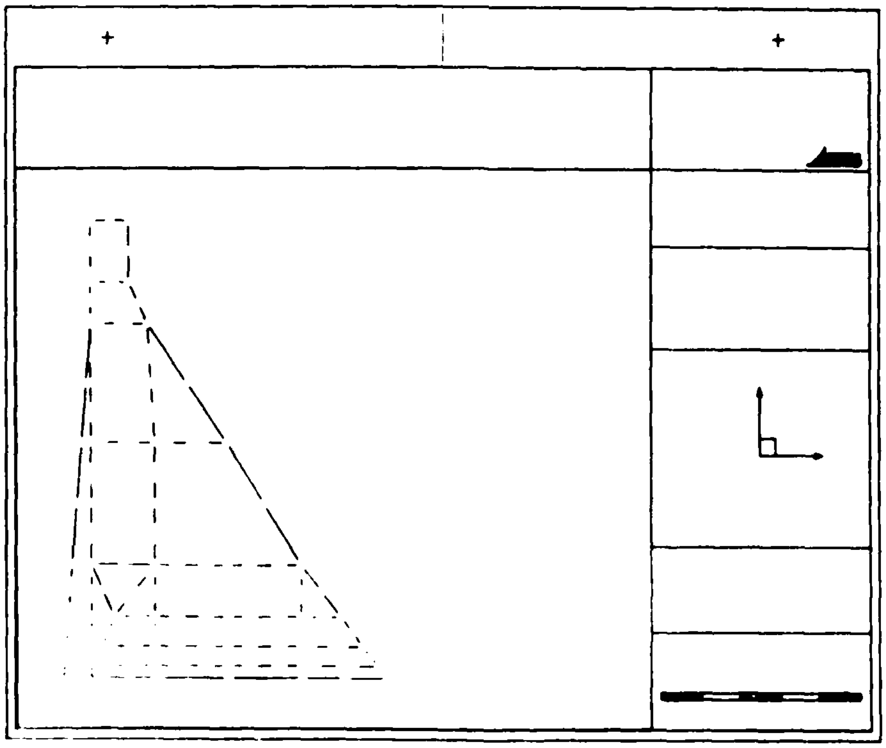


Figure B3. Nonannotated plot of 2-D dam fine grid nodes and elements

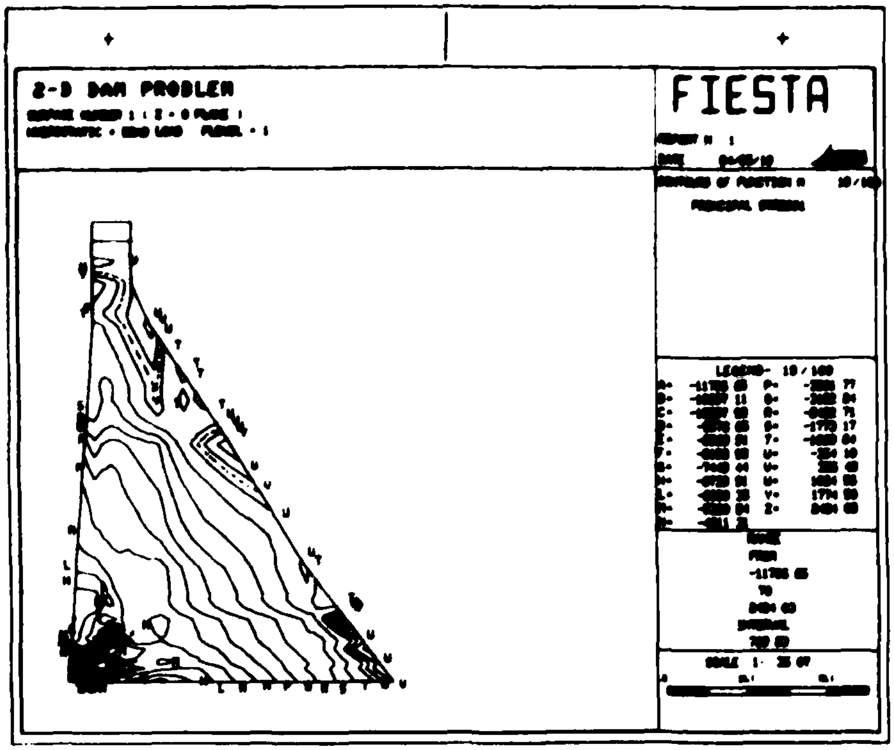


Figure B4. Annotated plot of X-direction principal stress contours, fine grid, P-level 1

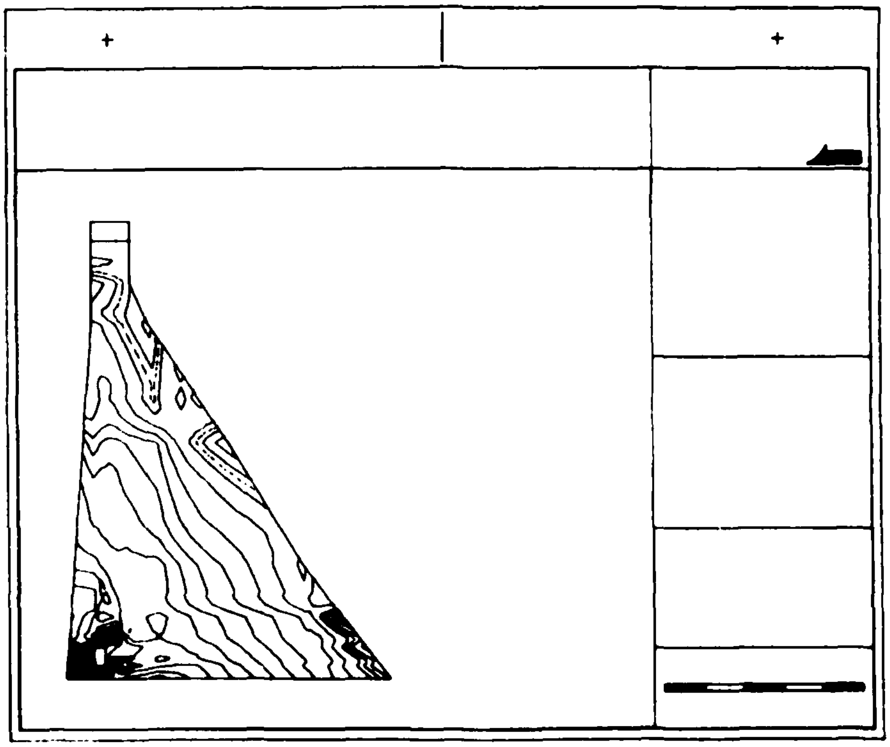


Figure B5. Nonannotated plot of X-direction principal stress contours, fine grid, P-level 1

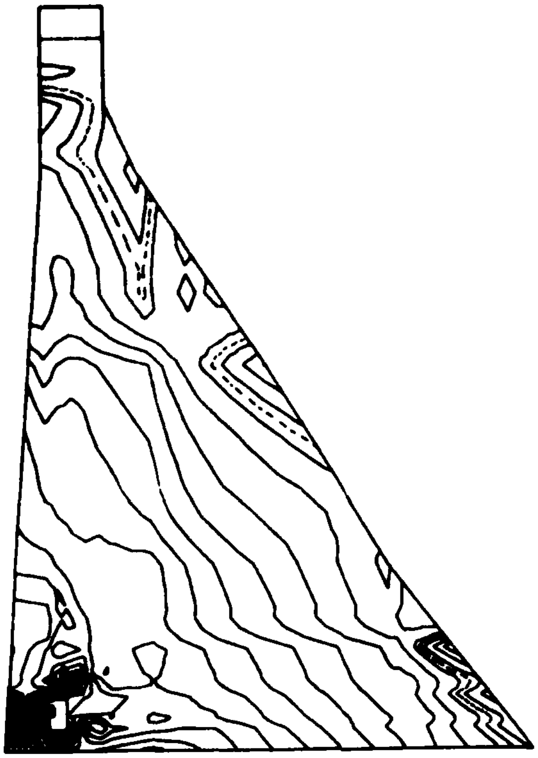


Figure B6. Window plot of nonannotated, X-direction principal stress contours without boundary, fine grid, P-level 1

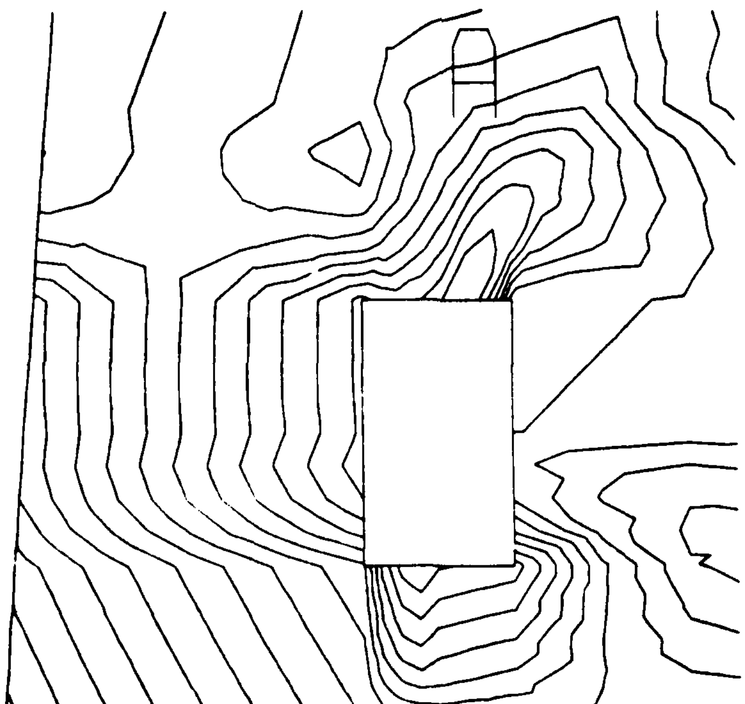


Figure B7. Subwindow plot of nonannotated, X-direction principal stress contours, fine grid, P-level 1

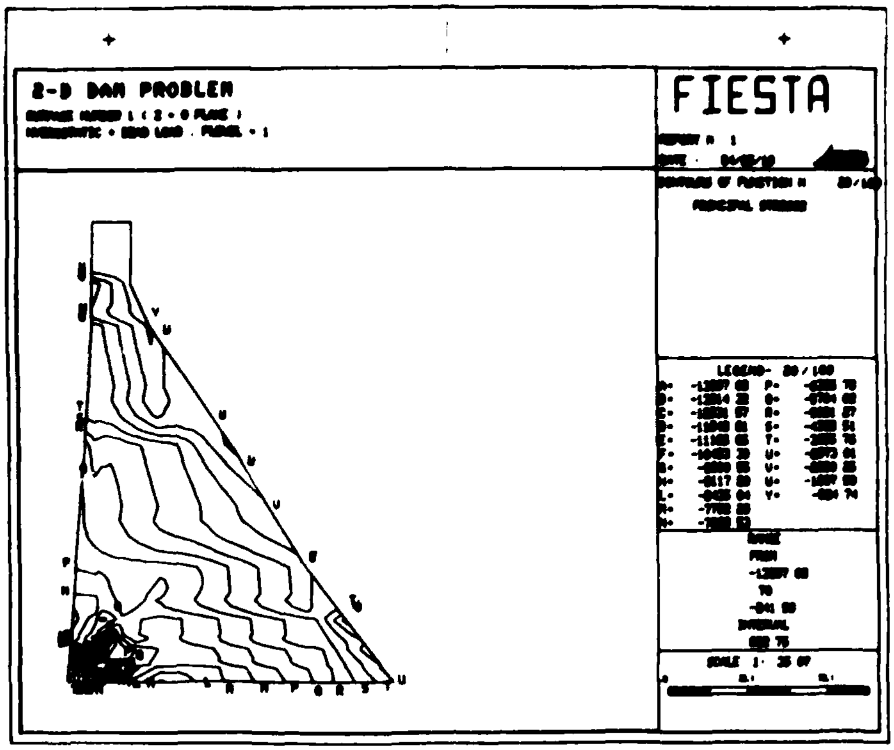


Figure B8. Annotated plot of Y-direction principal stress contours, fine grid, P-level 1

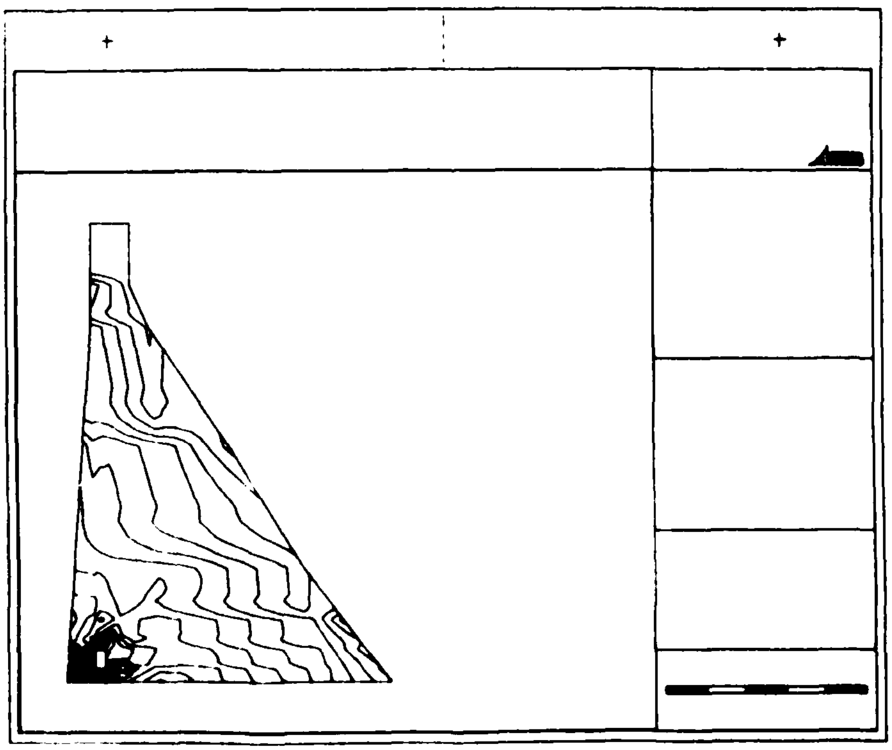


Figure B9. Nonannotated plot of Y-direction principal stress contours, fine grid, P-level 1

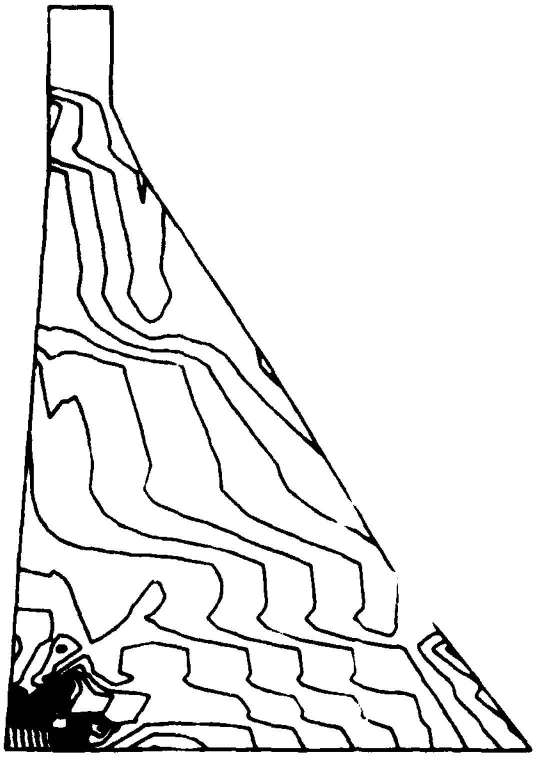


Figure B10. Window plot of nonannotated, Y-direction principal stress contours, fine grid, P-level 1

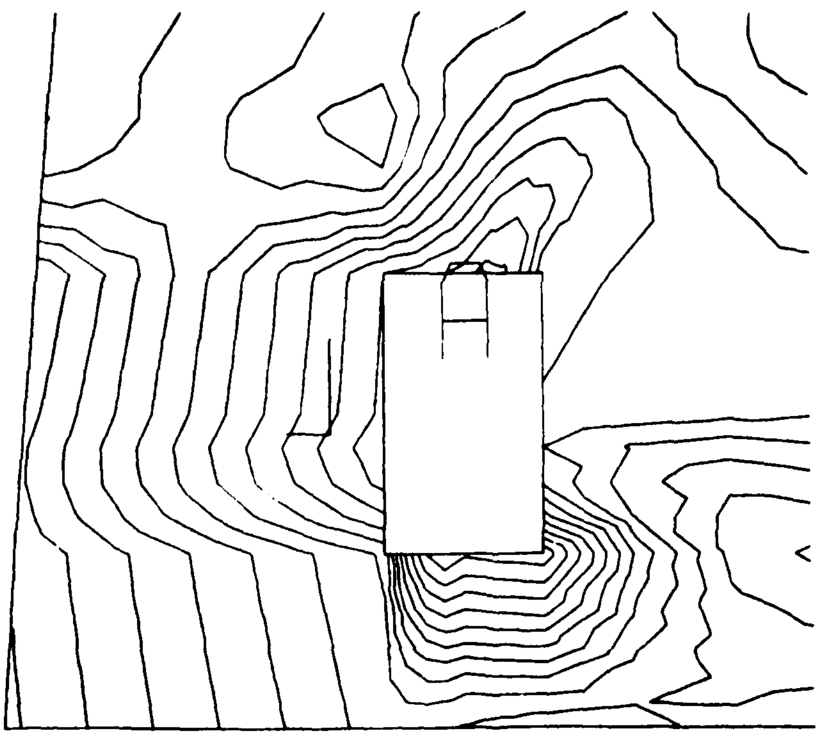


Figure B11. Subwindow plot of partially annotated, Y-direction principal stress contours, fine grid, P-level 1

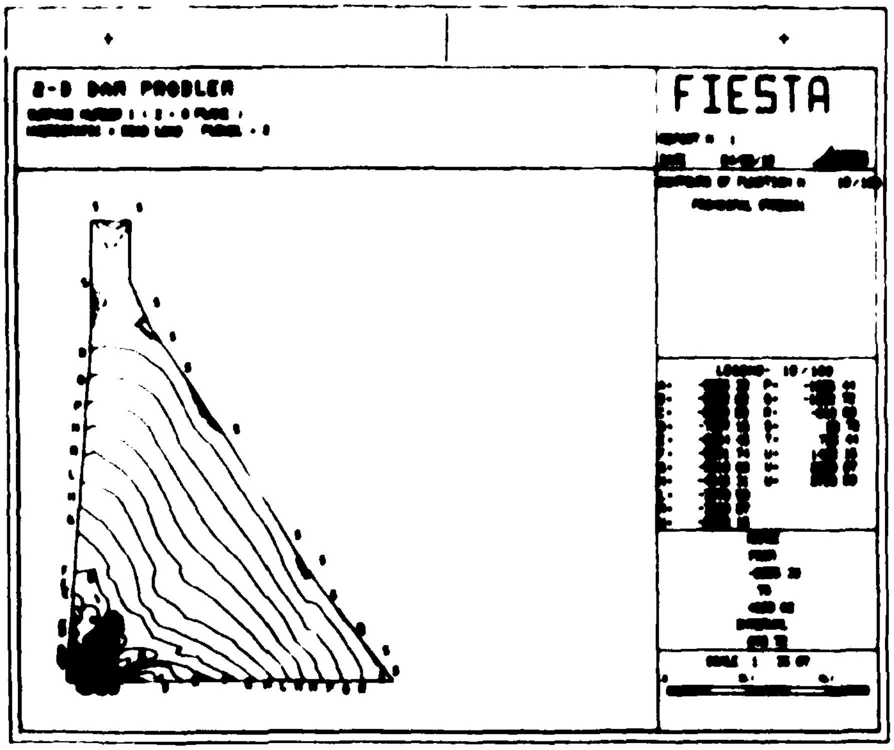


Figure B12. Annotated plot of X-direction principal stress contours, fine grid, P-level 2

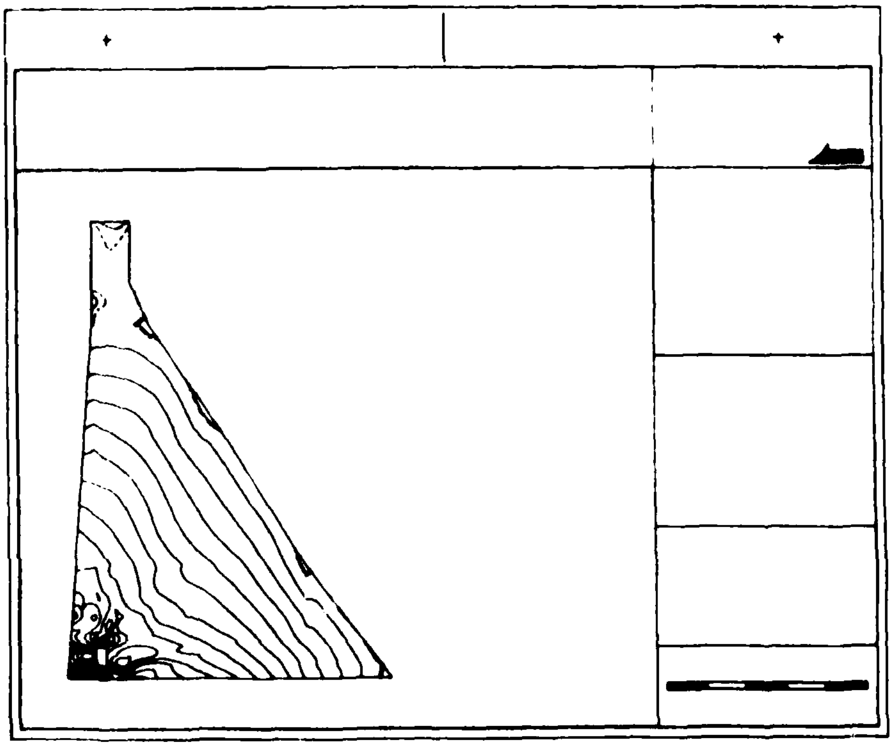


Figure B13. Nonannotated plot of X-direction principal stress contours, fine grid, P-level 2

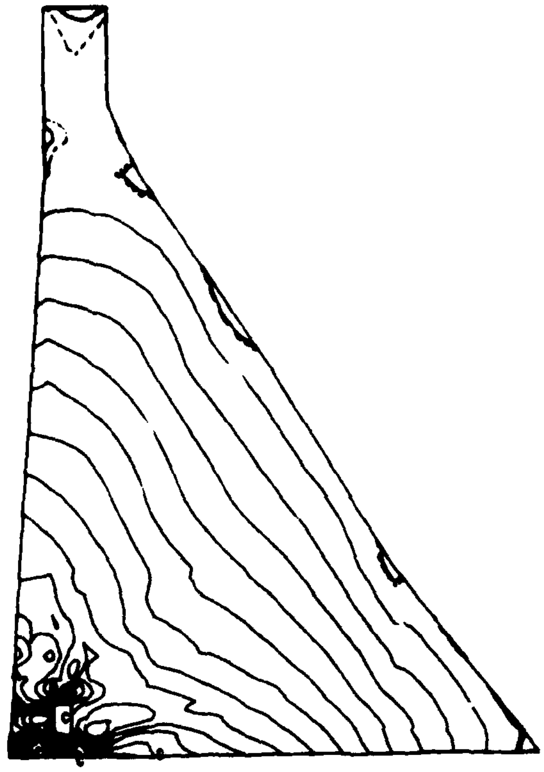


Figure B14. Window plot of partially annotated, X-direction principal stress contours, fine grid, P-level 2

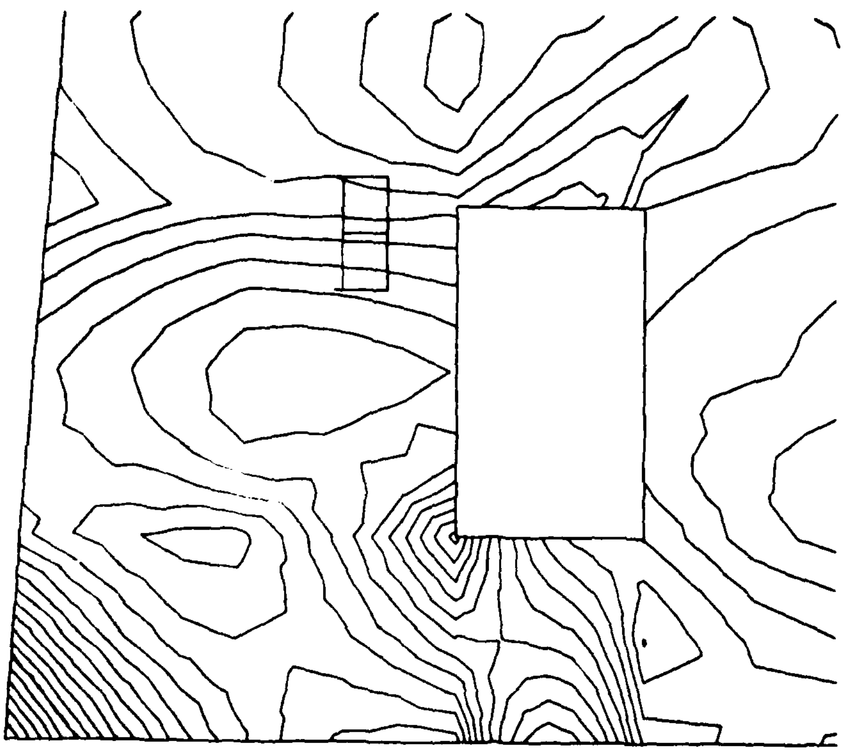


Figure B15. Subwindow plot of partially annotated, X-direction principal stress contours, fine grid, P-level 2

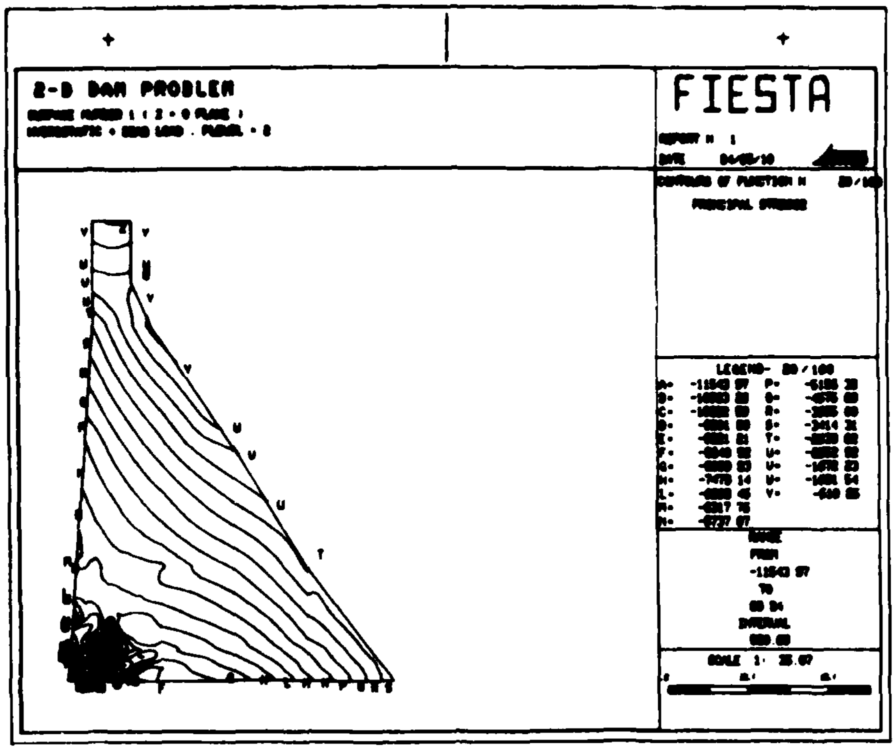


Figure B16. Annotated plot of Y-direction principal stress contours, fine grid, P-level 2

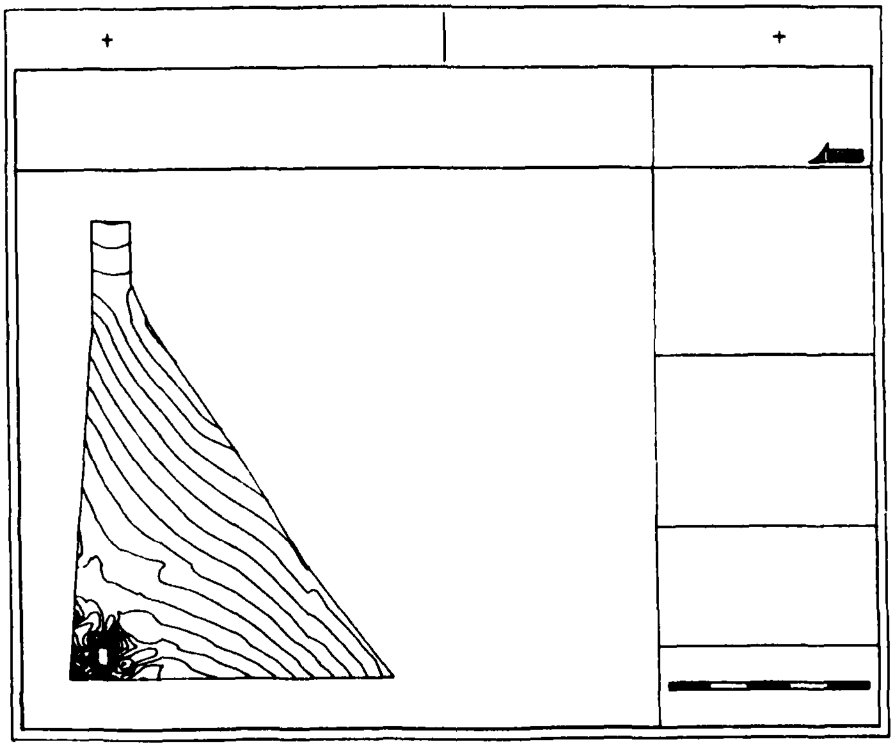


Figure B17. Nonannotated plot of Y-direction principal stress contours, fine grid, P-level 2

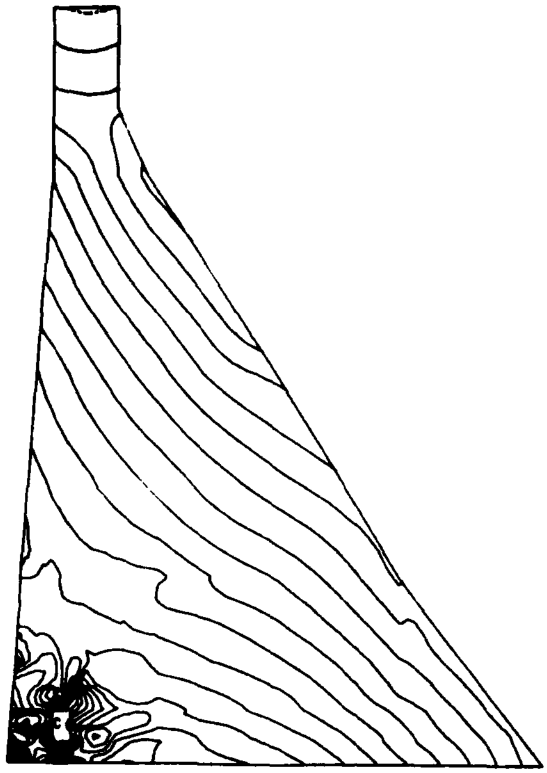


Figure B18. Window plot of partially annotated, Y-direction principal stress contours, fine grid, P-level 2

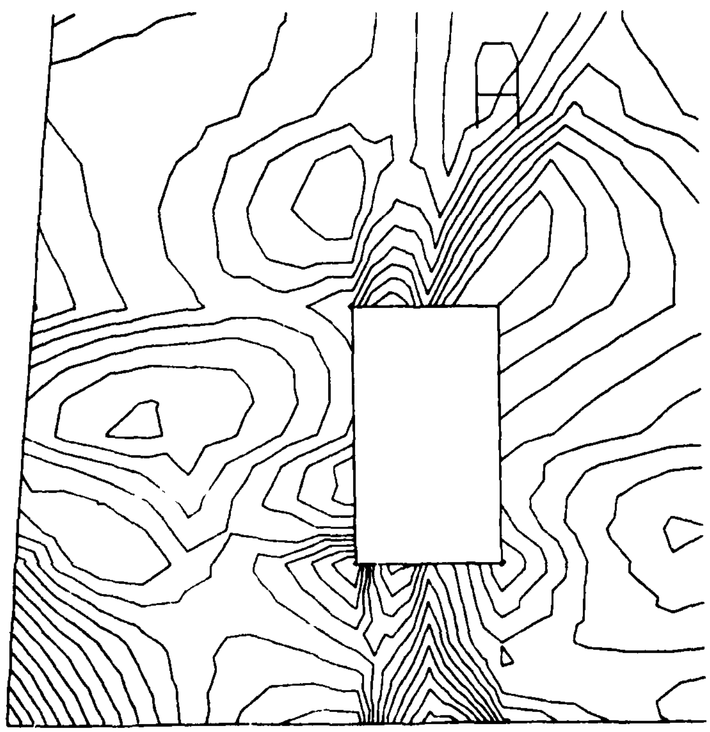


Figure B19. Subwindow plot of partially annotated, Y-direction principal stress contours, fine grid, P-level 2

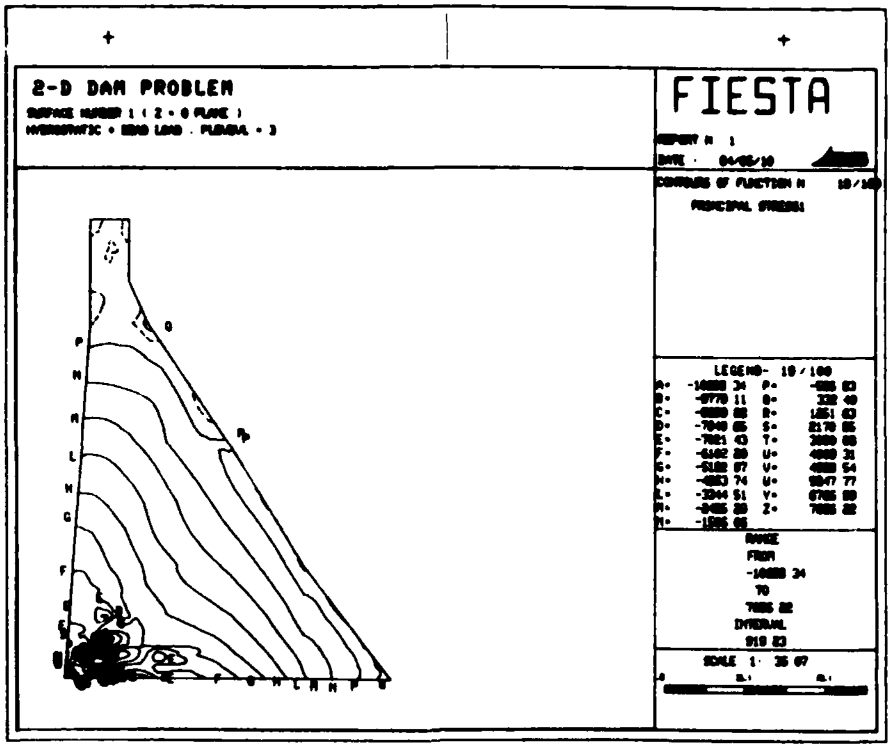


Figure B20. Annotated plot of X-direction principal stress contours, fine grid, P-level 3

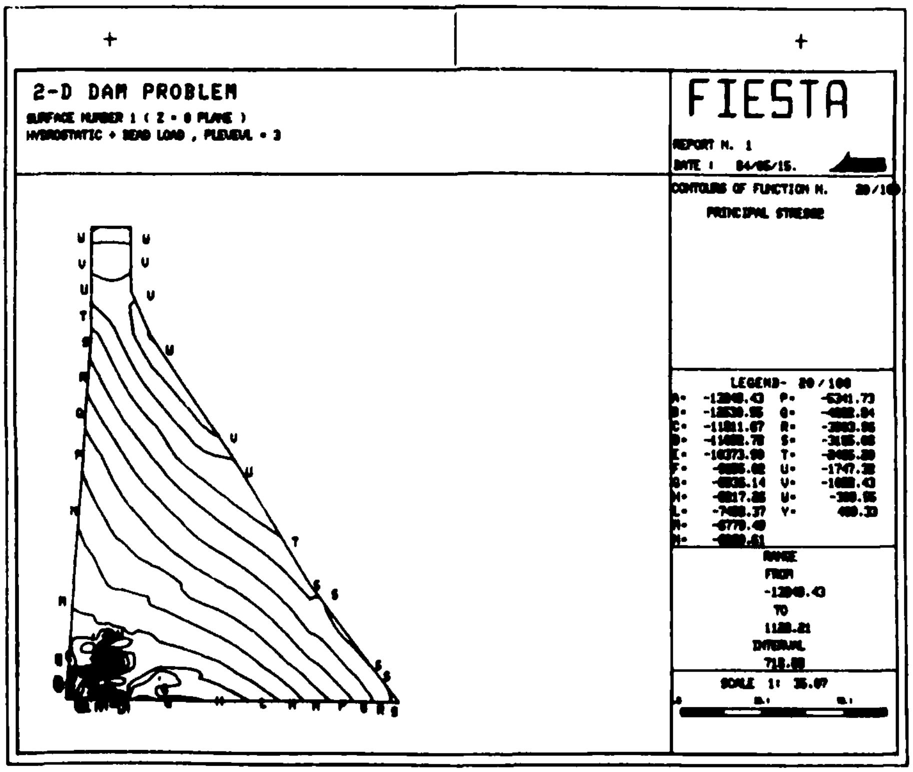


Figure B21. Annotated plot of Y-direction principal stress contours, fine grid, P-level 3

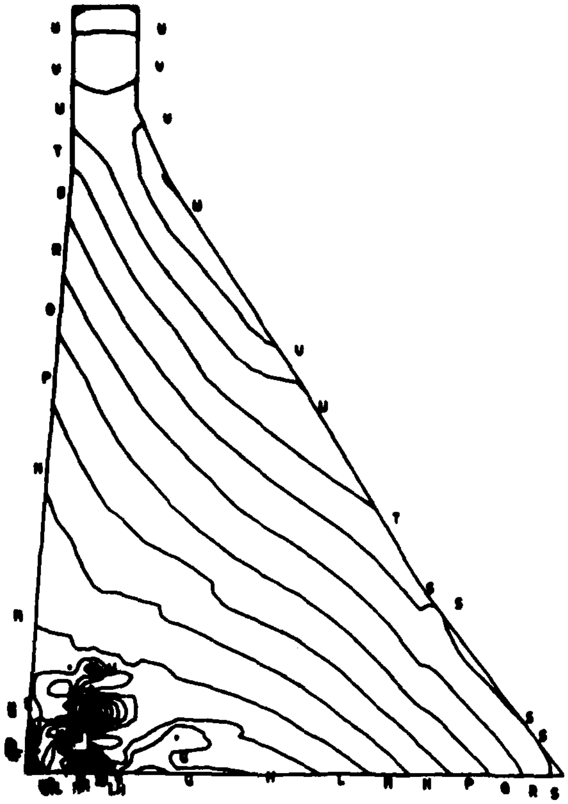


Figure B22. Window plot of annotated, Y-direction principal stress contours, fine grid, P-level 3

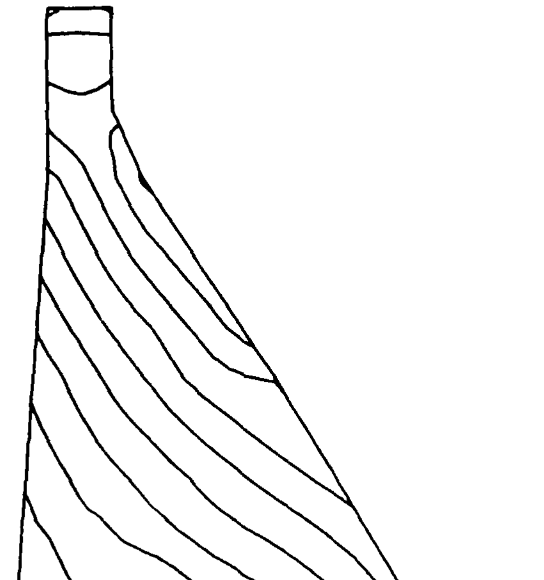


Figure B23. Window plot of nonannotated, Y-direction principal stress contours, fine grid, P-level 3

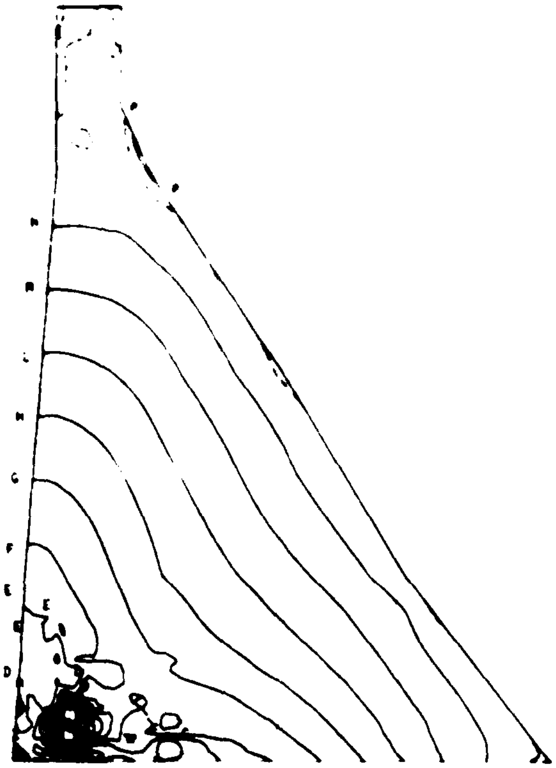


Figure B24. Annotated plot of X-direction principal stress contours, fine grid, P-level 5

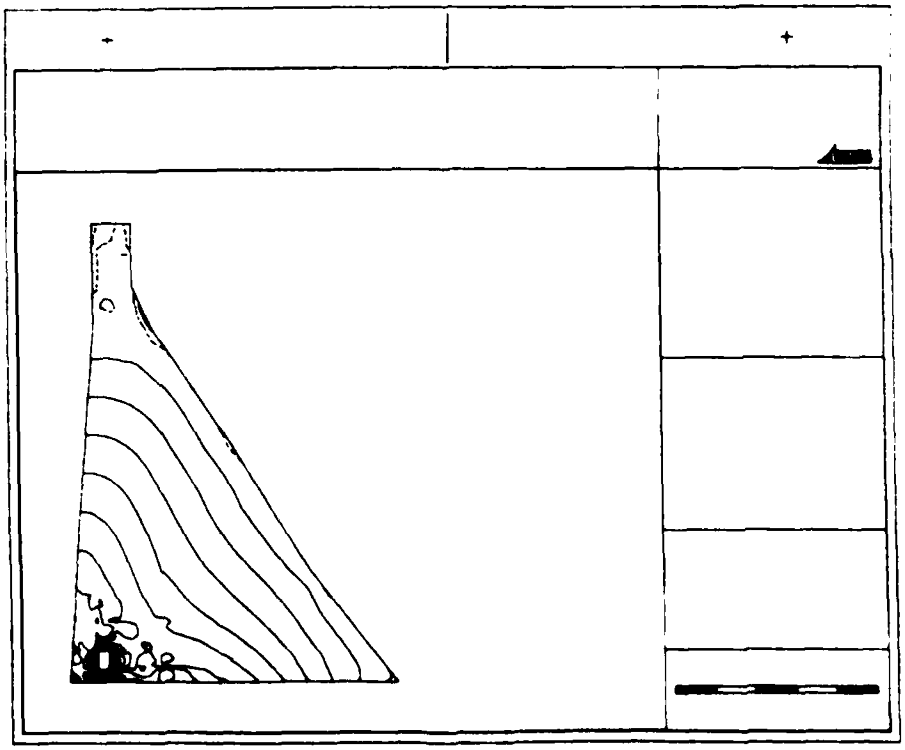


Figure B25. Nonannotated plot of X-direction principal stress contours, fine grid, P-level 5

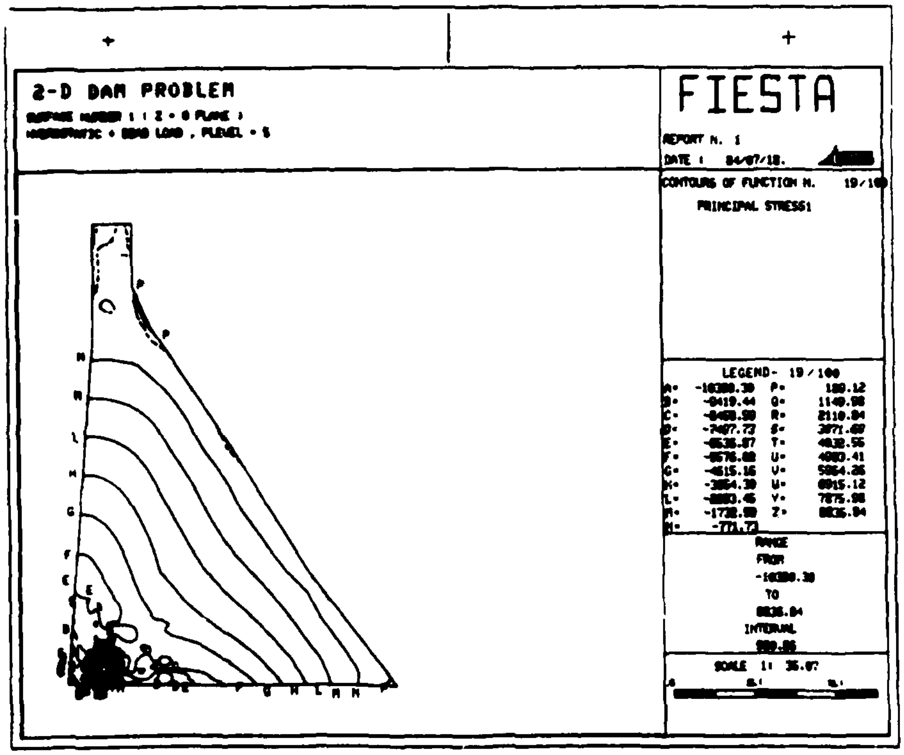


Figure B26. Window plot of annotated, X-direction principal stress contours, fine grid, P-level 5

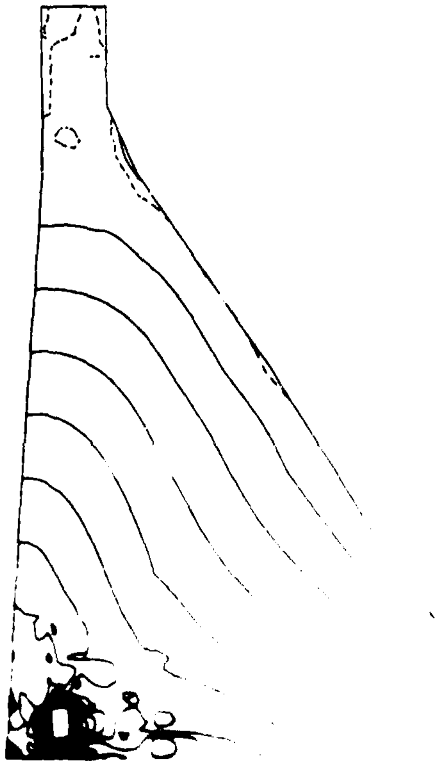
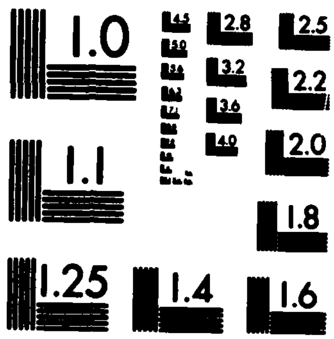


Figure B27. Window [illegible]
principal stress [illegible]

AD-A181 511 EVALUATION OF THE P-LEVEL FINITE-ELEMENT PROGRAM 'FIESTA'(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS INFORMATION TECHNOLOGY LAB 2/3

UNCLASSIFIED R L HALL ET AL. JAN 87 WES/TR/ITL-87-3 F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

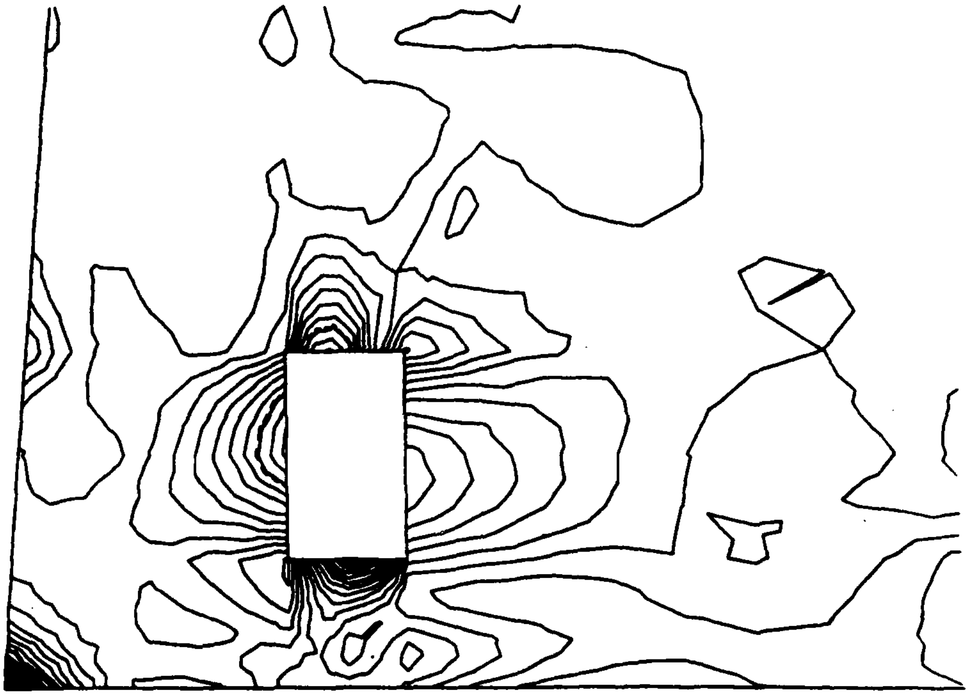


Figure B28. Subwindow plot of nonannotated, X-direction principal stress contours, fine grid, P-level 5

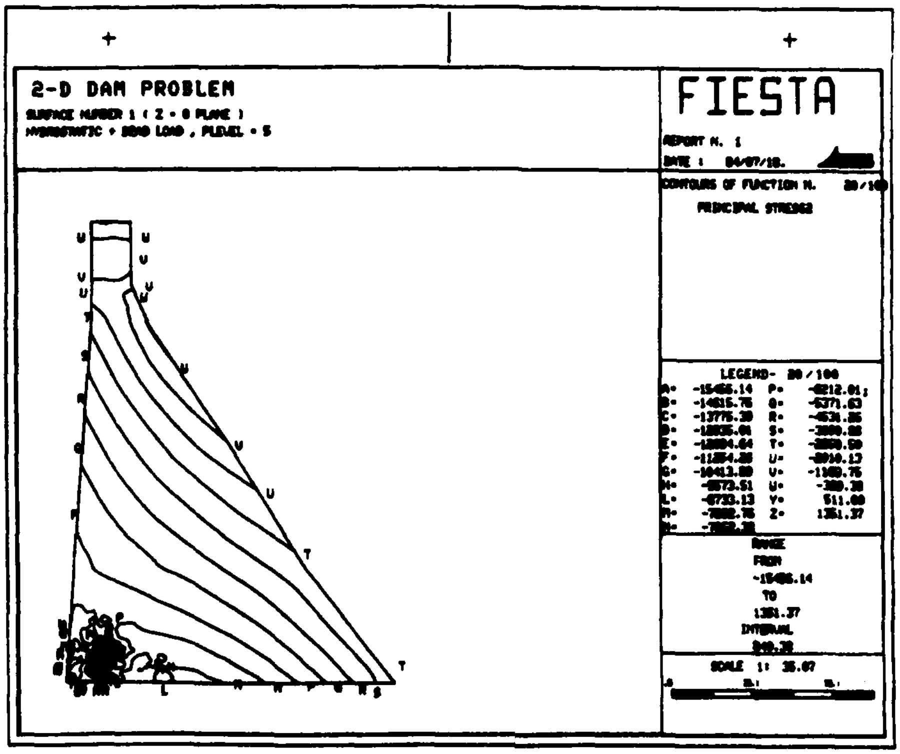


Figure B29. Annotated plot of Y-direction principal stress contours, fine grid, P-level 5

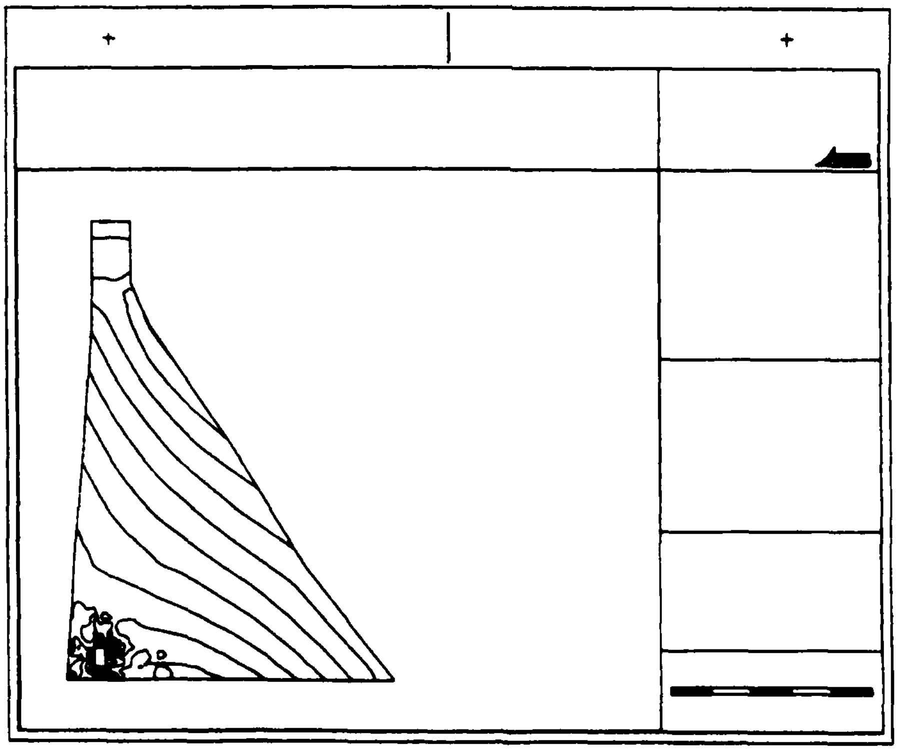


Figure B30. Nonannotated plot of Y-direction principal stress contours, fine grid, P-level 5

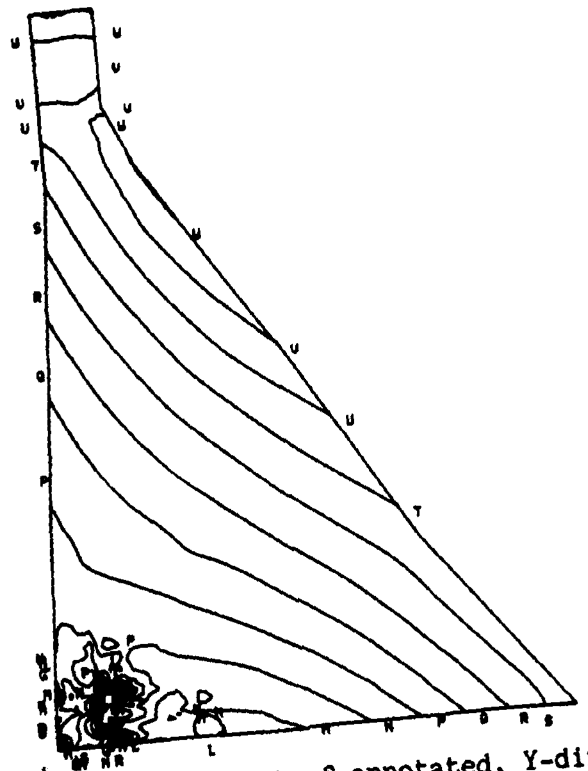


Figure B31. Window plot of annotated, Y-direction principal stress contours, fine grid, P-level 5

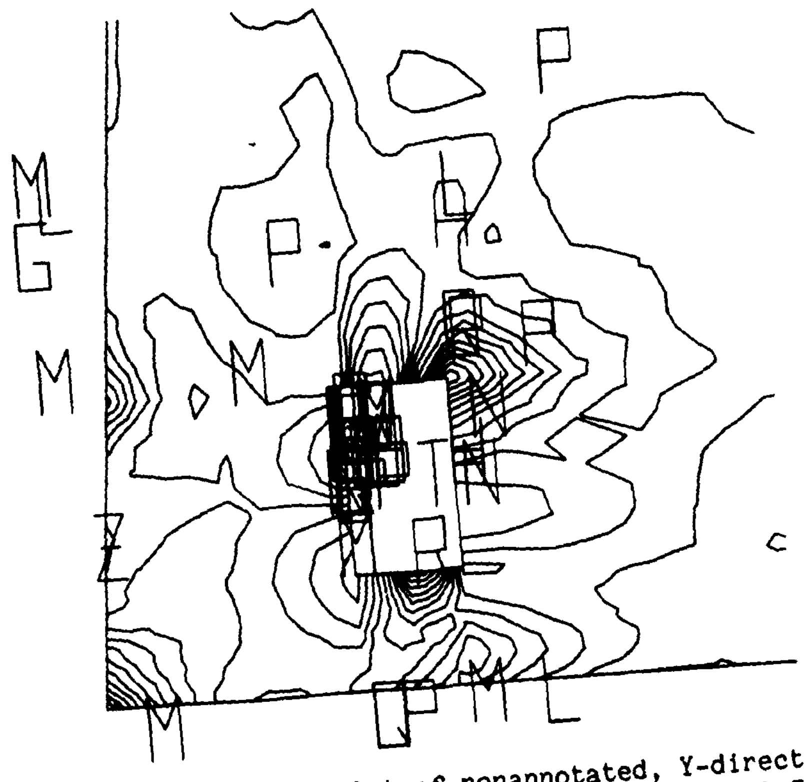


Figure B32. Window plot of nonannotated, Y-direction principal stress contours, fine grid, P-level 5

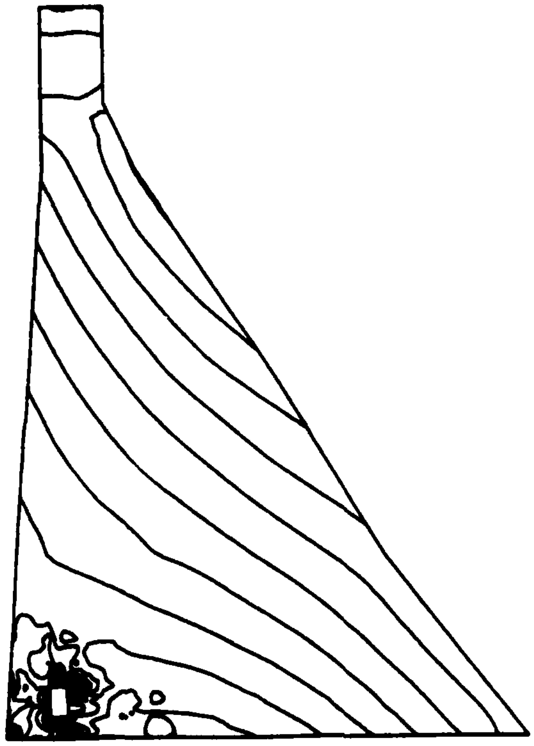


Figure B33. Window plot of annotated, Y-direction principal stress contours, fine grid, P-level 5

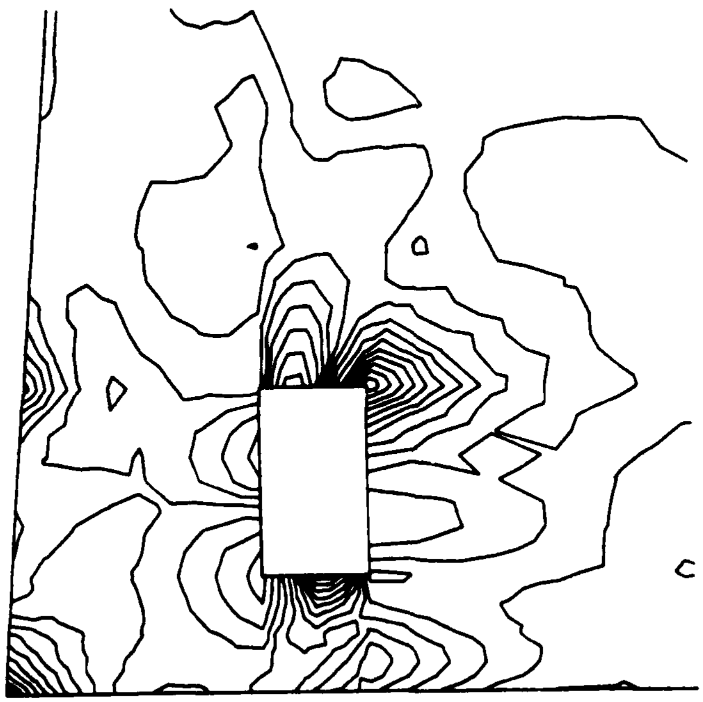


Figure B34. Window plot of nonannotated, Y-direction principal stress contours, fine grid, P-level 5

APPENDIX C: GTSTRUDL DAM FILES

Model 1

```
STRUDL 'FIRST MODEL OF CONC. DAM'
UNITS FEET POUNDS
JOINT COORIDATES
1 -11.92 0 SUPPORT
2 0 0 SUPPORT
3 5 0 SUPPORT
4 28.33 0 SUPPORT
5 93 0 SUPPORT
6 131.33 0 SUPPORT
7 -11.55 5
8 0 5
9 5 5
10 28.33 5
11 93 5
12 127.16 5
13 -10.83 13
14 0 13
15 5 13
16 28.33 13
17 93 13
18 120.5 13
19 -9.83 25
20 0 25
21 10 25
22 28.33 25
23 93 25
24 110.5 25
25 -8.333 46
26 0 46
27 28.33 46
28 93 46
29 -4 95
30 0 95
31 28.33 95
32 60.33 95
33 0 143
34 25.33 143
35 0 160
36 17 160
37 0 185
38 17 185
ELEMENT INCIDENCES
1 1 2 8 7
2 2 3 9 8
3 3 4 10 9
4 4 5 11 10
5 5 6 12 11
6 7 8 14 13
7 9 10 16 15
8 10 11 17 16
9 11 12 18 17
10 13 14 20 19
11 14 15 21 20
12 15 16 22 21
13 16 17 23 22
14 17 18 24 23
15 19 20 26 25
16 20 21 26
```

Model 1 (Concluded)

```
17 21 27 26
18 21 22 27
19 22 23 28 27
20 23 24 28
21 25 26 30 29
22 26 27 31 30
23 27 28 32 31
24 29 30 33
25 30 31 34 33
26 31 32 34
27 33 34 36 35
28 35 36 38 37
TYPE PLANE STRAIN
ELEMENTS 1 TO 6 25 27 28 PROPERTIES TYPE 'IPLQ' THICK 1.
ELEMENTS 7 TO 15 19 21 22 23  PROPERTIES TYPE 'IPLQ' THICK 1.
ELEMENTS 16 17 18 20 24 26 PROPERTIES TYPE 'CSTG' THICK 1.
CONTANTS E 4.32E8 ALL
POI .33 ALL
LOADING 1
ELEMENTS LOADS
1 TO 28 BODY FORCE GLOBAL BY -154.176
JOINT LOADS
1 FORCE X 30.9E3
7 FORCE X 47.E3
13 FORCE X 80.625E3
19 FORCE X 119.368E3
25 FORCE X 196.875E3
29 FORCE X 146.257E3
33 FORCE X 17.653E3
STIFFNESS ANALYSIS REDUCE BAND
LIST REACTION DISPLACEMENTS STRESSESS ALL
PLOT DEVICE SCOPE 4014 BAUD 120.
PLOT PROJ
HARDCOPY
END;PLOT CONT BD SXX LOAD 1
HARDCOPY
END;PLOT CONT BD SYY LOAD 1
HARDCOPY
END
FINISH
```

Model 2

```
STRUDL 'SECOND MODEL OF CONC. DAM'
UNITS FEET POUNDS
JOINT COORIDATES
1 -11.92 0 SUPPORT
2 0 0 SUPPORT
3 5 0 SUPPORT
4 28.33 0 SUPPORT
5 93 0 SUPPORT
6 131.33 0 SUPPORT
7 -11.55 5
8 0 5
9 5 5
10 28.33 5
11 93 5
12 127.16 5
13 -10.83 13
14 0 13
15 5 13
16 28.33 13
17 93 13
18 120.5 13
19 -9.83 25
20 0 25
21 10 25
22 28.33 25
23 93 25
24 110.5 25
25 -8.333 46
26 0 46
27 28.33 46
28 93 46
29 -4 95
30 0 95
31 28.33 95
32 60.33 95
33 0 143
34 25.33 143
35 0 160
36 17 160
37 0 185
38 17 185
39 60 0 SUPPORT
40 110.5 0 SUPPORT
41 60 5
42 110.5 5
43 60 13
44 110.3 13
45 60 25
46 8.5 46
47 60 46
48 -6.04 70.5
49 0 70.5
50 8.5 70.5
51 28.33 70.5
52 60 70.5
53 76.5 70.5
54 -2.0 119
55 0 119
56 8.5 119
57 28.33 119
58 44.16 119
59 8.5 143
60 0 151.5
61 8.5 151.5
62 21.167 151.5
63 8.5 160
64 0 172.5
65 8.5 172.5
66 17 172.5
67 8.5 185
68 8.5 95
ELEMENT INCIDENCES
1 1 2 8 7
2 2 3 9 8
3 3 4 10 9
4 4 39 41 10
5 39 5 11 41
6 5 40 42 11
7 40 6 12 42
8 7 8 14 13
9 9 10 16 15
10 10 41 43 16
11 41 11 17 43
12 11 42 44 17
13 42 12 18 44
14 13 14 20 19
15 14 15 21 20
16 15 16 22 21
17 16 43 45 22
18 43 17 23 45
19 17 44 24 23
20 44 18 24
21 19 20 26 25
22 20 21 46 26
23 21 22 27 46
24 22 45 47 27
25 45 23 28 47
26 23 24 28
27 25 26 49 48
28 26 46 50 49
29 46 27 51 50
30 27 47 52 51
31 47 28 53 52
32 48 49 30 29
33 49 50 68 30
34 50 51 31 68
35 51 52 32 31
36 52 53 32
37 29 30 55 54
38 30 68 56 55
39 68 31 57 56
40 31 32 58 57
41 54 55 33
42 55 56 59 33
43 56 57 34 59
44 57 58 34
45 33 59 61 60
```

Model 2 (Concluded)

```
46 59 34 62 61
47 60 61 63 35
48 61 62 36 63
49 35 63 65 64
50 63 36 66 65
51 64 65 67 37
52 65 66 38 67
TYPE PLANE STRAIN
ELEMENTS 1 TO 19 21 TO 25 27 TO 35 PROPERTIES TYPE 'IPLQ' THICK 1.
ELEMENTS 37 TO 40 42 43 45 TO 52  PROPERTIES TYPL 'IPLQ' THICK 1.
ELEMENTS 20 26 36 44 41 PROPERTIES TYPE 'CSTG' THICK 1.
CONTANTS E 4.32E8 ALL
POI .33 ALL
LOADING 1
ELEMENTS LOADS
1 TO 52 BODY FORCE GLOBAL BY -154.176
1 EDGE FORCE EDGE 4 GLOBAL VARIABLE VX 8937. 8625.
8 EDGE FORCE EDGE 4 GLOBAL VARIABLE VX 8625. 8125.
14 EDGE FORCE EDGE 4 GLOBAL VAR VX 8125. 7375.
21 EDGE FORCE EDGE 4 GLOBAL VAR VX 7375. 6062.5
27 EDGE FORCE EDGE 4 GLOBAL VAR VX 6062.5 4531.25
32 EDGE FORCE EDGE 4 GLOBAL VAR VX 4531.5 3000.
37 EDGE FORCE EDGE 4 GLOBAL VAR VX 3000. 1500.
JOINT LOADS
38 FORCE X 4500.
54 FORCE X 13500
STIFFNESS ANALYSIS REDUCE BAND
LIST REACTION DISPLACEMENTS STRESSESS ALL
PLOT DEVICE SCOPE 4014 BAUD 120.
PLOT PROJ
HARDCOPY;END
PLOT CONT BD SXX LOAD 1
HARDCOPY;END
PLOT CONT SYY LOAD 1
HARDCOPY;END
FINISH
```

Model 3

```
STRUDL 'THIRD MODEL'
UNITS FEET POUNDS
JOINT COORIDATES
   1    0.      143.000
   2    0.   130.875
   3   10.333   143.000
   4   -1.042   130.875
   5    0.  151.500
   6    0.    118.750
   7   10.333   130.875
   8    8.708   151.500
   9   17.832   143.000
  10   -2.083   118.750
  11    0.    160.000
  12    0.    106.625
  13   10.333   118.750
  14   18.186   130.875
  15   17.416   151.500
  16    8.500   160.000
  17   25.330   143.000
  18   -3.125   106.625
  19    0.    172.500
  20    0.         94.500
  21   10.333   106.625
  22   18.540   118.750
  23   26.039   130.875
  24   17.000   160.000
  25   21.165   151.500
  26    8.500   172.500
  27   33.789   130.875
  28   -4.166    94.500
  29    0.    185.000
  30    0.         82.375
  31   10.333    94.500
  32   18.895   106.625
  33   26.747   118.750
  34   17.000   172.500
  35    8.500   185.000
  36   34.866   118.750
  37   42.247   118.750
  38   -5.208    82.375
  39    0.         70.250
  40   10.333    82.375
  41   19.249    94.500
  42   27.456   106.625
  43   17.000   185.000
  44   35.944   106.625
  45   43.817   106.625
  46   50.706   106.625
  47   -6.250    70.250
  48    0.         58.125
  49   10.333    70.250
  50   19.603    82.375
  51   28.165    94.500
  52   37.022    94.500
  53   45.387    94.500
  54   52.965    94.500
  55   59.165    94.500
  56   -7.291    58.125
  57    0.       46.000
  58   10.333    58.125
  59   19.958    70.250
  60   28.874    82.375
  61   38.100    82.375
  62   46.957    82.375
  63   55.224    82.375
  64   67.624    82.375
  65   -8.333    46.000
  66    0.       37.750
  67   10.333    46.000
  68   20.312    58.125
  69   29.582    70.250
  70   39.178    70.250
  71   48.527    70.250
  72   57.482    70.250
  73   69.194    70.250
  74   76.083    70.250
  75   -8.957    37.750
  76    0.       29.500
  77    9.000    37.750
  78   20.667    46.000
  79   30.291    58.125
  80   40.256    58.125
  81   50.097    58.125
  82   59.741    58.125
  83   70.764    58.125
  84   84.541    58.1
  85   -9.582    29.500
  86    0.       21.250
  87    7.667    29.500
  88   20.395    38.333
  89   31.000    46.000
  90   41.333    46.000
  91   51.667    46.000
  92   62.000    46.000
  93   72.333    46.000
  94   82.667    46.000
  95   93.000    46.000
  96  -10.206    21.250
  97    0.    13.000
  98    6.333    21.250
  99   20.123    30.667
 100   30.767    38.333
 101   41.139    38.333
 102   51.511    38.333
 103   61.884    38.333
 104   72.256    38.333
 105   82.628    38.333
 106   93.000    38.333
 107   99.389    38.333
 108  -10.830 13.000
 109    0.          5.000
 110    5.000 13.000
 111   19.852    23.000
 112   30.534    30.667
 113   40.945    30.667
 114   51.356    30.667
 115   61.767    30.667
 116   72.178    30.667
 117   82.589    30.667
 118   93.000    30.667
 119   99.388    30.667
 120  105.777    30.667
 121  -11.550     5.000
 122    0.0   0.0 S
 123    5.000     5.000
 124   19.580 15.333
 125   30.301    23.000
 126   40.751    23.000
 127   51.201    23.000
 128   61.651    23.000
 129   72.100    23.000
 130   82.550    23.000
 131   93.000    23.000
 132   99.388    23.000
 133  105.777    23.000
 134  112.165    23.000
 135  -11.920              0.0 S
 136    5.000              0. S
 137   19.308      7.667
 138   30.069 15.333
 139   40.557 15.333
 140   51.046 15.333
 141   61.534 15.333
 142   72.023 15.333
 143   82.511 15.333
 144   93.000 15.333
 145   99.388 15.333
 146  105.777 15.333
 147  112.165 15.333
 148  118.553 15.333
 149   19.037              0.0 S
 150   29.836      7.667
 151   40.363      7.667
 152   50.890      7.667
 153   61.418      7.667
 154   71.945      7.667
 155   82.473      7.667
 156   93.000      7.667
 157   99.388      7.667
 158  105.777      7.667
 159  112.165      7.667
 160  118.553      7.667
 161  124.942      7.667
 162   29.603              0. S
 163   40.169              0. S
 164   50.735              0. S
 165   61.301              0. S
 166   71.868              0. S
 167   82.434              0. S
 168   93.000              0. S
 169   99.388              0. S
 170  105.777              0. S
 171  112.165              0. S
 172  118.553              0. S
 173  124.942              0. S
```

Model 3 (Continued)

174 131.330 0. S

ELEMENT INCIDENCES

1	135	122	109	121
2	122	136	123	109
3	136	149	137	123
4	174	161	173	
5	109	97	108	121
6	123	137	124	110
7	110	124	111	98
8	98	111	99	87
9	87	99	88	77
10	77	88	78	67
11	110	98	86	97
12	98	87	76	86
13	87	77	66	76
14	77	67	57	66
15	97	86	96	108
16	86	76	85	96
17	76	66	75	85
18	66	57	65	75
19	65	57	48	56
20	57	67	58	48
21	48	58	49	39
22	39	49	40	30
23	30	40	31	20
24	20	31	21	12
25	12	21	13	6
26	6	13	7	2
27	2	7	3	1
28	95	106	107	
29	95	84	94	
30	95	94	105	106
31	94	93	104	105
32	93	92	103	104
33	92	91	102	103
34	91	90	101	102
35	90	89	100	101
36	89	78	88	100
37	106	105	117	118
38	105	104	116	117
39	104	103	115	116
40	103	102	114	115
41	102	101	113	114
42	101	100	112	113
43	100	88	99	112
44	118	117	130	131
45	117	116	129	130
46	116	115	128	129
47	115	114	127	128
48	114	113	126	127
49	113	112	125	126
50	112	99	111	125
51	131	130	143	144
52	130	129	142	143
53	129	128	141	142
54	128	127	140	141
55	127	126	139	140
56	126	125	138	139
57	125	111	124	138
58	144	143	155	156
59	143	142	154	155
60	142	141	153	154
61	141	140	152	153
62	140	139	151	152
63	139	138	150	151
64	138	124	137	150
65	156	155	167	168
66	155	154	166	167
67	154	153	165	166
68	153	152	164	165
69	152	151	163	164
70	151	150	162	163
71	150	137	149	162
72	1	4	2	
73	1	3	8	5
74	3	9	15	8
75	5	8	16	11
76	8	15	24	16
77	17	23	27	
78	17	25	15	9
79	17	9	14	23
80	23	14	22	33
81	33	22	32	42
82	42	32	41	51
83	51	41	50	60
84	60	50	59	69
85	69	59	68	79
86	79	68	78	89
87	11	16	26	19
88	16	24	34	26
89	19	26	35	29
90	26	34	43	35
91	24	15	25	
92	67	78	68	58
93	58	68	59	49
94	49	59	50	40
95	40	50	41	31
96	31	41	32	21
97	21	32	22	13
98	13	22	14	7
99	7	14	9	3
100	56	48	39	47
101	39	30	38	47
102	38	30	20	28
103	20	12	18	28
104	18	12	6	10
105	6	2	4	10
106	89	90	80	79
107	79	80	70	69
108	69	70	61	60
109	60	61	52	51
110	51	52	44	42
111	42	44	36	33
112	33	36	27	23
113	90	91	81	80
114	80	81	71	70
115	70	71	62	61
116	61	62	53	52

```
 117   52   53   45   44
 118   44   45   37   36
 119   91   92   82   81
 120   81   82   72   71
 121   71   72   63   62
 122   62   63   54   53
 123   53   54   46   45
 124   92   93   83   82
 125   82   83   73   72
 126   72   73   64   63
 127   93   94   84   83
 128   84   74   73   83
 129   74   64   73
 130   64   55   54   63
 131   55   46   54
 132   46   37   45
 133   37   27   36
 134  168  169  157  156
 135  169  170  158  157
 136  170  171  159  158
 137  171  172  160  159
 138  172  173  161  160
 139  106  118  119  107
 140  107  119  120
 141  118  131  132  119
 142  119  132  133  120
 143  131  144  145  132
 144  132  145  146  133
 145  133  146  147  134
 146  144  156  157  145
 147  145  157  158  146
 148  146  158  159  147
 149  147  159  160  148
 150  120  133  134
 151  134  147  148
 152  148  160  161
TYPE PLANE STRAIN
ELEMENTS 1 2 3 5 TO 27 30 TO 71 73 TO 76 78 TO 90 PROPERTIES TYPE 'IPLQ' THICK 1.
ELEMENTS 92 TO 128 130 134 TO 139 141 TO 149 PROPERTIES TYPE 'IPLQ' THICK 1.
ELEMENTS 4 28 29 72 77 91 129 131 132 133 140 150 TO 152 PROPERTIES TYPE 'CSTG' THICK 1.
CONTANTS POI .33 ALL
CONTANTS E 4.32E8 ALL
LOADING 1
ELEMENT LJADS
1 TO 152 BODY FORCE GLOBAL BY -154.176
  1 EDGE FORCE EDGE 4 GLOBAL  VAR VX 8937.5 8625.
  5 EDGE FORCE EDGE 3 GLOBAL  VAR VX 8625. 8125.
  15 EDGE FORCE EDGE 3 GLOBAL  VAR VX 8125. 7609.375
  16 EDGE FORCE EDGE 3 GLOBAL  VAR VX 7609.375 7093.75
  17 EDGE FORCE EDGE 3 GLOBAL  VAR VX 7093.75 6578.125
   18 EDGE FORCE EDGE 3 GLOBAL  VAR VX 6578.125 6062.5
  19 EDGE FORCE EDGE 4 GLOBAL  VAR VX 6062.5 5304.687
  100 EDGE FORCE EDGE 4 GLOBAL  VAR VX 5304.687 4546.875
  101 EDGE FORCE EDGE 3 GLOBAL  VAR VX 4546.875 3789.062
  102 EDGE FORCE EDGE 4 GLOBAL  VAR VX 3789.062 3031.250
  103 EDGE FORCE EDGE 3 GLOBAL  VAR VX 23031.25 2273.437
  104 EDGE FORCE EDGE 4 GLOBAL  VAR VX 2273.437 1515.620
  105 EDGE FORCE EDGE 3 GLOBAL  VAR VX 1515.620 757.812
 JOINT LOADS
4 FORCE X 1147.0425
1 FORCE X 3442.419
STIFFNESS ANALYSIS REDUCE BAND
LIST REACTIONS DISPLACEMENTS STRESSESS ALL
PLOT DEVICE SCOPE 4014 BAUD 120.
PLOT PROJ;LABEL ALL
HARDCOPY;PLOT CONT BD SXX LOAD 1
HARDCOPY;PLOT CONT BD SYY LOAD 1
HARDCOPY;END
SAVE DIRECT 'PRCDAM'
FINISH
```

APPENDIX D: PLATE STUDY FILES AND PLOTS

```
PTTHN1      12:23 MAY 15,'84

$TOP
THIN PLATE
1 0. 0. .5
2 5. 0. .5
3 10. 0. .5
4 0. 5. .5
5 5. 5. .5
6 10. 5. .5
7 0. 10. .5
8 5. 10. .5
9 10. 10. .5
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
$CHECK
$CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
$PLEVEL
1
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
$CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL=1
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 1
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 1
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
```

Figure D1. Data file for FIESTA P-level 1 analysis and plotting of thin plate problem

```
PTTHN2     12:21 MAY 15,'84

00100 %TOP
00110 THIN PLATE
00120 1 0. 0. .5
00130 2 5. 0. .5
00140 3 10. 0. .5
00150 4 0. 5. .5
00160 5 5. 5. .5
00170 6 10. 5. .5
00180 7 0. 10. .5
00190 8 5. 10. .5
00200 9 10. 10. .5
00210 10 0. 0. 0.
00220 11 5. 0. 0.
00230 12 10. 0. 0.
00240 13 0. 5. 0.
00250 14 5. 5. 0.
00260 15 10. 5. 0.
00270 16 0. 10. 0.
00280 17 5. 10. 0.
00290 18 10. 10. 0.
00300 END OF COORDINATES
00310 31 1 10 11 14 13 1 2 5 4
00320 31 2 11 12 15 14 2 3 6 5
00330 31 3 13 14 17 16 4 5 8 7
00340 31 4 14 15 18 17 5 6 9 8
00350 END OF INCIDENCES
00360 NO LOCAL COOR SYSTEM
00370 0
00380 NO EQUIVALENTING
00390 0
00400 %SURF
00410 1
00420 10.
00430 %MPLOT
00440 1
00450 101 5 1 1 1 0 2 0 0 0
00460 -60. 15. 15.
00470 END PLOT ID
00480 4
00490 1 101 0 0 0
00500 3-D GEOMETRY PLOT
00510 END OF PLOT DATA
00520 %CHECK
00530 %CONST
00540 3 0 1 2 3
00550 5 6
00560 3 0 1
00570 3
00580 3 0 2
00590 4
00600 END OF CONST
00610 %PROP
00620 1
00630 ALL
00640 END OF MATERIAL DISP
00650 1 0 0 0
00660 4.176E9 .27
00670 15.2174 6.6E-6
00680 END OF MATERIAL PROPERTIES
00690 %PLEVEL
00700 2
00710 ALL
00720 END OF PLEVEL DEF
00730 NO LIST
00740 %LOADS
00750 1
00760 UNIFORM PRESSURE IN -Z DIRECTION
00770 3
00780 3 100.
00790 2
00800 END OF UNIFORM PRESSURE
00810 END OF LOAD CASE 1
00820 2
00830 GRAVITY LOADING IN -Z DIRECTION
00840 0
00850 0. 0. -32.2
00860 ALL
00870 END OF LOAD CASE 2
00880 3
00890 TEMPERATURE LOAD OF DELTA= 50 DEG
00900 11
00910 70. 120.
00920 END OF TEMP DEF
00930 ALL
00940 END OF LOAD CASE 3
00950 END OF LOADS
00960 %LCOMB
00970 11
00980 LOAD COMBINATION 11
00990 1 1
01000 END OF LOAD COMBINATION 11
01010 12
01020 LOAD COMBINATION 12
01030 2 1
01040 END OF LOAD COMBINATION 12
01050 13
01060 LOAD COMBINATION 13
01070 3 1
01080 END OF LOAD COMBINATION 13
01090 END OF LOAD COMBINATION DEF
01100 %LOVE
01110 %ARRAY
01120 %STIFF
01130 %STATIC
01140 %SOLVE
01150 %DISP
01160 %STRESS
01170 0
01180 ALL
01190 ALL
01200 %AXES
01210 10 0 0
01220 0. 0. 0. 0
01230 END OF LOCAL AXES SYSTEM = 10
01240 %CMESH
01250 1
01260 Z=5 PLANE (SURFACE NO. 2)
01270 2 0 1
01280 0. 0. 10.
01290 3
01300 2
01310 END OF CMESH
01320 %CDATA
01330 100 11 0 1 0 1
01340 RESULTS OF UNIFORM PRESSURE , PLEVEL = 2
01350 110 12 0 1 0 1
01360 RESULTS OF DEAD LOAD , PLEVEL = 2
01370 120 13 0 1 1 1
01380 RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 2
01390 END OF CDATA
01400 %CPLOT
01410 1
01420 200 5 0 1 1 0 1 0. 0.
01430 0. 0. 10.
01440 END PLOTID
01450 6
01460 19 100 200 0 0 0 0 0
01470 PRINCIPAL STRESS1
01480 20 100 200 0 0 0 0 0
01490 PRINCIPAL STRESS2
01500 19 110 200 0 0 0 0 0
01510 PRINCIPAL STRESS1
01520 20 110 200 0 0 0 0 0
01530 PRINCIPAL STRESS2
01540 19 120 200 0 0 0 0 0
01550 PRINCIPAL STRESS1
01560 20 120 200 0 0 0 0 0
01570 PRINCIPAL STRESS2
01580 END OF PLOT DATA
01590 %ENDP
$
```

Figure D2. Data file for FIESTA P-level 2 analysis and plotting of thin plate problem

```
$
PTTHN3     12:18 MAY 15,'84

$TOP
THIN PLATE
1 0. 0. .5
2 5. 0. .5
3 10. 0. .5
4 0. 5. .5
5 5. 5. .5
6 10. 5. .5
7 0. 10. .5
8 5. 10. .5
9 10. 10. .5
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
$CHECK
$CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
$PLEVEL
3
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
2-5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
$CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL = 3
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 3
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 3
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure D3. Data file for FIESTA P-level 3 analysis and plotting of thin plate problem

PTTHN4 12:13 MAY 15,'84

```
*TOP
THIN PLATE
1 0. 0. .5
2 5. 0. .5
3 10. 0. .5
4 0. 5. .5
5 5. 5. .5
6 10. 5. .5
7 0. 10. .5
8 5. 10. .5
9 10. 10. .5
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
*SURF
1
10.
*MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
*CHECK
*CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
*PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
*PLEVEL
4
ALL
END OF PLEVEL DEF
NO LIST
*LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
*LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
*LOVE
*ARRAY
*STIFF
*STATIC
*SOLVE
*DISP
*STRESS
0
ALL
ALL
*AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
*CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
*CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL = 4
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 4
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 4
END OF CDATA
*CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
*ENDP
$
```

Figure D4. Data file for FIESTA P-level 4 analysis and plotting of thin plate problem

```
PTTHNS      14:27 JUL 16,'84

*TOP
THIN PLATE
1 0. 0. .5
2 5. 0. .5
3 10. 0. .5
4 0. 5. .5
5 5. 5. .5
6 10. 5. .5
7 0. 10. .5
8 5. 10. .5
9 10. 10. .5
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
*SURF
1
10.
*MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
*CHECK
*CONST
3 0 1 2 3
5 6
3 0 1
1
3 0 2
4
END OF CONST
*PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
*PLEVEL
5
ALL
END OF PLEVEL DEF
NO LIST
*LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
9
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
*LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
*LOVE
*ARRAY
*STIFF
*STATIC
*SOLVE
*DISP
*STRESS
0
ALL
ALL
*AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM - 10
*CMESH
1
Z-5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
*CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL = 5
110 12 0 1 0 1
RESULTS OF DEAD(LOAD , PLEVEL = 5
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 5
END OF CDATA
*CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
*ENDP
*(
```

Figure D5. Data file for FIESTA P-level 5 analysis and plotting of thin plate problem

```
PTTHCK1    12:36 MAY 15,'84

$TOP
THICK PLATE
1 0. 0. 5.
2 5. 0. 5.
3 10. 0. 5.
4 0. 5. 5.
5 5. 5. 5.
6 10. 5. 5.
7 0. 10. 5.
8 5. 10. 5.
9 10. 10. 5.
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
$CHECK
$CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END CF MATERIAL PROPERTIES
$PLEVEL
1
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
$CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL=1
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 1
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 1
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure D6. Data file for FIESTA P-level 1 analysis and plotting of thick plate problem

```
PTTHCK2     12:37 MAY 15,'84

00100 $TOP
00110 THICK PLATE
00120 1 0. 0. 5.
00130 2 5. 0. 5.
00140 3 10. 0. 5.
00150 4 0. 5. 5.
00160 5 5. 5. 5.
00170 6 10. 5. 5.
00180 7 0. 10. 5.
00190 8 5. 10. 5.
00200 9 10. 10. 5.
00210 10 0. 0. 0.
00220 11 5. 0. 0.
00230 12 10. 0. 0.
00240 13 0. 5. 0.
00250 14 5. 5. 0.
00260 15 10. 5. 0.
00270 16 0. 10. 0.
00280 17 5. 10. 0.
00290 18 10. 10. 0.
00300 END OF COORDINATES
00310 31 1 10 11 14 13 1 2 5 4
00320 31 2 11 12 15 14 2 3 6 5
00330 31 3 13 14 17 16 4 5 8 7
00340 31 4 14 15 18 17 5 6 9 8
00350 END OF INCIDENCES
00360 NO LOCAL COOR SYSTEM
00370 0
00380 NO EQUIVALENTING
00390 0
00400 $SURF
00410 1
00420 10.
00430 $MPLOT
00440 1
00450 101 5 1 1 1 0 2 0 0 0
00460 -60. 15. 15.
00470 END PLOT ID
00480 4
00490 1 101 0 0 0
00500 3-D GEOMETRY PLOT
00510 END OF PLOT DATA
00520 $CHECK
00530 $CONST
00540 3 0 1 2 3
00550 5 6
00560 3 0 1
00570 3
00580 3 0 2
00590 4
00600 END OF CONST
00610 $PROP
00620 1
00630 ALL
00640 END OF MATERIAL DISP
00650 1 0 0 0
00660 4.176E9 .27
00670 15.2174 6.6E-6
00680 END OF MATERIAL PROPERTIES
00690 $PLEVEL
00700 2
00710 ALL
00720 END OF PLEVEL DEF
00730 NO LIST
00740 $LOADS
00750 1
00760 UNIFORM PRESSURE IN -Z DIRECTION
00770 3
00780 3 100.
00790 2
00800 END OF UNIFORM PRESSURE
00810 END OF LOAD CASE 1
00820 2
00830 GRAVITY LOADING IN -Z DIRECTION
00840 8
00850 0. 0. -32.2
00860 ALL
00870 END OF LOAD CASE 2
00880 3
00890 TEMPERATURE LOAD OF DELTA= 50 DEG
00900 11
00910 70. 120.
00920 END OF TEMP DEF
00930 ALL
00940 END OF LOAD CASE 3
00950 END OF LOADS
00960 $LCOMB
00970 11
00980 LOAD COMBINATION 11
00990 1 1
01000 END OF LOAD COMBINATION 11
01010 12
01020 LOAD COMBINATION 12
01030 2 1
01040 END OF LOAD COMBINATION 12
01050 13
01060 LOAD COMBINATION 13
01070 3 1
01080 END OF LOAD COMBINATION 13
01090 END OF LOAD COMBINATION DEF
01100 $LOVE
01110 $ARRAY
01120 $STIFF
01130 $STATIC
01140 $SOLVE
01150 $DISP
01160 $STRESS
01170 0
01180 ALL
01190 ALL
01200 $AXES
01210 10 0 0
01220 0. 0. 0. 0
01230 END OF LOCAL AXES SYSTEM = 10
01240 $CMESH
01250 1
01260 Z=5 PLANE (SURFACE NO. 2)
01270 2 0 1
01280 0. 0. 10.
01290 3
01300 2
01310 END OF CMESH
01320 $CDATA
01330 100 11 0 1 0 1
01340 RESULTS OF UNIFORM PRESSURE , PLEVEL = 2
01350 110 12 0 1 0 1
01360 RESULTS OF DEAD LOAD , PLEVEL = 2
01370 120 13 0 1 1 1
01380 RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 2
01390 END OF CDATA
01400 $CPLOT
01410 1
01420 200 5 0 1 1 0 1 0. 0.
01430 0. 0. 10.
01440 END PLOTID
01450 6
01460 19 100 200 0 0 0 0 0
01470 PRINCIPAL STRESS1
01480 20 100 200 0 0 0 0 0
01490 PRINCIPAL STRESS2
01500 19 110 200 0 0 0 0 0
01510 PRINCIPAL STRESS1
01520 20 110 200 0 0 0 0 0
01530 PRINCIPAL STRESS2
01540 19 120 200 0 0 0 0 0
01550 PRINCIPAL STRESS1
01560 20 120 200 0 0 0 0 0
01570 PRINCIPAL STRESS2
01580 END OF PLOT DATA
01590 $ENDP
$
```

Figure D7. Data file for FIESTA P-level 2 analysis and plotting of thick plate problem

```
PTTHCK3    12:39 MAY 15,'84

*TOP
THICK PLATE
1 0. 0. 5.
2 5. 0. 5.
3 10. 0. 5.
4 0. 5. 5.
5 5. 5. 5.
6 10. 5. 5.
7 0. 10. 5.
8 5. 10. 5.
9 10. 10. 5.
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
*SURF
1
10.
*MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
*CHECK
*CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
*PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
*PLEVEL
3
ALL
END OF PLEVEL DEF
NO LIST
*LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
*LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
*LOVE
*ARRAY
*STIFF
*STATIC
*SOLVE
*DISP
*STRESS
0
ALL
ALL
*AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
*CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
*CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL = 3
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 3
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 3
END OF CDATA
*CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
*ENDP
*
```

Figure D8. Data file for FIESTA P-level 3 analysis and plotting of thick plate problem

```
PTTHCK4    12:41 MAY 15,'84

$TOP
THICK PLATE
1 0. 0. 5.
2 5. 0. 5.
3 10. 0. 5.
4 0. 5. 5.
5 5. 5. 5.
6 10. 5. 5.
7 0. 10. 5.
8 5. 10. 5.
9 10. 10. 5.
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
$CHECK
$CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
$PLEVEL
4
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
$CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL = 4
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 4
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 4
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PPINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure D9. Data file for FIESTA P-level 4 analysis and plotting of thick plate problem

```
PTTHCKS    14:59 JUL 16,'84

$TOP
THICK PLATE
1 0. 0. 5.
2 5. 0. 5.
3 10. 0. 5.
4 0. 5. 5.
5 5. 5. 5.
6 10. 5. 5.
7 0. 10. 5.
8 5. 10. 5.
9 10. 10. 5.
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
$CHECK
$CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
$PLEVEL
5
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
$CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM LOAD , PLEVEL = 5
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 5
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 5
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 2 0 0
PRINCIPAL STRESS2
19 110 200 0 0 2 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 2 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure D10. Data file for FIESTA P-level 5 analysis and plotting of thick plate problem

```
$
PTMDTH1    12:25 MAY 15,'84

$TOP
MODERATELY THICK PLATE
1 0. 0. 1.5
2 5. 0. 1.5
3 10. 0. 1.5
4 0. 5. 1.5
5 5. 5. 1.5
6 10. 5. 1.5
7 0. 10. 1.5
8 5. 10. 1.5
9 10. 10. 1.5
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
$CHECK
$CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
$PLEVEL
1
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
$CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL=1
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 1
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 1
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure D11. Data file for FIESTA P-level 1 analysis and plotting of moderately thick plate problem

```
PTMDTH2    12:28 MAY 15,'84

$TOP
MODERATELY THICK PLATE
1 0. 0. 1.5
2 5. 0. 1.5
3 10. 0. 1.5
4 0. 5. 1.5
5 5. 5. 1.5
6 10. 5. 1.5
7 0. 10. 1.5
8 5. 10. 1.5
9 10. 10. 1.5
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
$CHECK
$CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
$PLEVEL
2
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
$CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL = 2
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 2
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 2
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure D12. Data file for FIESTA P-level 2 analysis and plotting of moderately thick plate problem

```
PTMDTH3    12:30 MAY 15,'84

$TOP
MODERATELY THICK PLATE
1 0. 0. 1.5
2 5. 0. 1.5
3 10. 0. 1.5
4 0. 5. 1.5
5 5. 5. 1.5
6 10. 5. 1.5
7 0. 10. 1.5
8 5. 10. 1.5
9 10. 10. 1.5
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
$CHECK
$CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
$PLEVEL
3
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
$CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL = 3
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 3
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 3
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure D13. Data file for FIESTA P-level 3 analysis and plotting of moderately thick plate problem

```
PTMDTH4    12:32 MAY 15,'84

$TOP
MODERATELY THICK PLATE
1 0. 0. 1.5
2 5. 0. 1.5
3 10. 0. 1.5
4 0. 5. 1.5
5 5. 5. 1.5
6 10. 5. 1.5
7 0. 10. 1.5
8 5. 10. 1.5
9 10. 10. 1.5
10 0. 0. 0.
11 5. 0. 0.
12 10. 0. 0.
13 0. 5. 0.
14 5. 5. 0.
15 10. 5. 0.
16 0. 10. 0.
17 5. 10. 0.
18 10. 10. 0.
END OF COORDINATES
31 1 10 11 14 13 1 2 5 4
31 2 11 12 15 14 2 3 6 5
31 3 13 14 17 16 4 5 8 7
31 4 14 15 18 17 5 6 9 8
END OF INCIDENCES
NO LOCAL COOR SYSTEM
0
NO EQUIVALENTING
0
$SURF
1
10.
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
3-D GEOMETRY PLOT
END OF PLOT DATA
$CHECK
$CONST
3 0 1 2 3
5 6
3 0 1
3
3 0 2
4
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0 0
4.176E9 .27
15.2174 6.6E-6
END OF MATERIAL PROPERTIES
$PLEVEL
4
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
UNIFORM PRESSURE IN -Z DIRECTION
3
3 100.
2
END OF UNIFORM PRESSURE
END OF LOAD CASE 1
2
GRAVITY LOADING IN -Z DIRECTION
8
0. 0. -32.2
ALL
END OF LOAD CASE 2
3
TEMPERATURE LOAD OF DELTA= 50 DEG
11
70. 120.
END OF TEMP DEF
ALL
END OF LOAD CASE 3
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1
END OF LOAD COMBINATION 11
12
LOAD COMBINATION 12
2 1
END OF LOAD COMBINATION 12
13
LOAD COMBINATION 13
3 1
END OF LOAD COMBINATION 13
END OF LOAD COMBINATION DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
Z=5 PLANE (SURFACE NO. 2)
2 0 1
0. 0. 10.
3
2
END OF CMESH
$CDATA
100 11 0 1 0 1
RESULTS OF UNIFORM PRESSURE , PLEVEL = 4
110 12 0 1 0 1
RESULTS OF DEAD LOAD , PLEVEL = 4
120 13 0 1 1 1
RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 4
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0. 0.
0. 0. 10.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
19 110 200 0 0 0 0 0
PRINCIPAL STRESS1
20 110 200 0 0 0 0 0
PRINCIPAL STRESS2
19 120 200 0 0 0 0 0
PRINCIPAL STRESS1
20 120 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure D14. Data file for FIESTA P-level 4 analysis and plotting of moderately thick plate problem

```
PTMDTHS    15:03 JUL 16,'84

00100 $TOP
00110 MODERATELY THICK PLATE
00120 1 0. 0. 1.5
00130 2 5. 0. 1.5
00140 3 10. 0. 1.5
00150 4 0. 5. 1.5
00160 5 5. 5. 1.5
00170 6 10. 5. 1.5
00180 7 0. 10. 1.5
00190 8 5. 10. 1.5
00200 9 10. 10. 1.5
00210 10 0. 0. 0.
00220 11 5. 0. 0.
00230 12 10. 0. 0.
00240 13 0. 5. 0.
00250 14 5. 5. 0.
00260 15 10. 5. 0.
00270 16 0. 10. 0.
00280 17 5. 10. 0.
00290 18 10. 10. 0.
00300 END OF COORDINATES
00310 31 1 10 11 14 13 1 2 5 4
00320 31 2 11 12 15 14 2 3 6 5
00330 31 3 13 14 17 16 4 5 8 7
00340 31 4 14 15 18 17 5 6 9 8
00350 END OF INCIDENCES
00360 NO LOCAL COOR SYSTEM
00370 0
00380 NO EQUIVALENTING
00390 0
00400 $SURF
00410 1
00420 10.
00430 $MPLOT
00440 1
00450 101 5 1 1 1 0 2 0 0 0
00460 -60. 15. 15.
00470 END PLOT ID
00480 4
00490 1 101 0 0 0
00500 3-D GEOMETRY PLOT
00510 END OF PLOT DATA
00520 $CHECK
00530 $CONST
00540 3 0 1 2 3
00550 5 6
00560 3 0 1
00570 3
00580 3 0 2
00590 4
00600 END OF CONST
00610 $PROP
00620 1
00630 ALL
00640 END OF MATERIAL DISP
00650 1 0 0 0
00660 4.176E9 .27
00670 15.2174 6.6E-6
00680 END OF MATERIAL PROPERTIES
00690 $PLEVEL
00700 5
00710 ALL
00720 END OF PLEVEL DEF
00730 NO LIST
00740 $LOADS
00750 1
00760 UNIFORM PRESSURE IN -Z DIRECTION
00770 3
00780 3 100.
00790 2
00800 END OF UNIFORM PRESSURE
00810 END OF LOAD CASE 1
00820 2
00830 GRAVITY LOADING IN -Z DIRECTION
00840 8
00850 0. 0. -32.2
00860 ALL
00870 END OF LOAD CASE 2
00880 3
00890 TEMPERATURE LOAD OF DELTA= 50 DEG
00900 11
00910 70. 120.
00920 END OF TEMP DEF
00930 ALL
00940 END OF LOAD CASE 3
00950 END OF LOADS
00960 $LCOMB
00970 11
00980 LOAD COMBINATION 11
00990 1 1
01000 END OF LOAD COMBINATION 11
01010 12
01020 LOAD COMBINATION 12
01030 2 1
01040 END OF LOAD COMBINATION 12
01050 13
01060 LOAD COMBINATION 13
01070 3 1
01080 END OF LOAD COMBINATION 13
01090 END OF LOAD COMBINATION DEF
01100 $LOVE
01110 $ARRAY
01120 $STIFF
01130 $STATIC
01140 $SOLVE
01150 $DISP
01160 $STRESS
01170 0
01180 ALL
01190 ALL
01200 $AXES
01210 10 0 0
01220 0. 0. 0. 0
01230 END OF LOCAL AXES SYSTEM = 10
01240 $CMESH
01250 1
01260 Z=5 PLANE (SURFACE NO. 2)
01270 2 0 1
01280 0. 0. 10.
01290 3
01300 2
01310 END OF CMESH
01320 $CDATA
01330 100 11 0 1 0 1
01340 RESULTS OF UNIFORM LOAD , PLEVEL = 5
01350 110 12 0 1 0 1
01360 RESULTS OF DEAD LOAD , PLEVEL = 5
01370 120 13 0 1 1 1
01380 RESULTS OF 50 DEG TEMP CHANGE , PLEVEL = 5
01390 END OF CDATA
01400 $CPLOT
01410 1
01420 200 5 0 1 1 0 1 0. 0.
01430 0. 0. 10.
01440 END PLOTID
01450 6
01460 19 100 200 0 0 0 0 0
01470 PRINCIPAL STRESS1
01480 20 100 200 0 0 0 0 0
01490 PRINCIPAL STRESS2
01500 19 110 200 0 0 0 0 0
01510 PRINCIPAL STRESS1
01520 20 110 200 0 0 0 0 0
01530 PRINCIPAL STRESS2
01540 19 120 200 0 0 0 0 0
01550 PRINCIPAL STRESS1
01560 20 120 200 0 0 0 0 0
01570 PRINCIPAL STRESS2
01580 END OF PLOT DATA
01590 $ENDP
$
```

Figure D15. Data file for FIESTA P-level 5 analysis and plotting of moderately thick plate problem

```
STRUDL ' THIN PLATE '
UNITS FEET
TYPE PLATE BENDING
GENERATE 9 JOINTS ID 1,1 X 0,1.25 Y 0,0
MODIFY 4 ID 14 Y 2.5
GENERATE 5 JOINTS ID 10,1 X 0,2.5 Y 1.25,0
MODIFY 3 ID 14 Y 2.5
GENERATE 4 ELEMENTS ID 1,1 FROM 1,2 TO 3,2 TO 17,2 TO 15,2 -
 TO 2,2 TO 11,1 TO 16,2 TO 10,1
MODIFY 3 ID 4 FROM 14 TO 14 TO 14 TO 14 TO 14 TO 14 TO 14 TO 14
STATUS SUPPORT 1 TO 9,57 TO 65,10 TO 52 BY 14,15 TO 43 BY 14, -
 14 TO 56 BY 14, 23 TO 51 BY 14
JOINT RELEASES
2 TO 8 MOMENT Y
10 TO 52 BY 14,15 TO 43 BY 14 MOMENT X
1 TO 8,10 TO 52 BY 14,15 TO 43 BY 14 FORCE Z
ELEMENTS 1 TO 16 PROPERTIES TYPE 'IPBQQ' THICK .5
CONSTANTS
E 4.176E9 ALL
POI .27 ALL
CTE 6.6E-6 ALL
LOADING 1 '100PSF UNIFORM LOAD'
ELEMENT LOADS
1 TO 16 SURFACE FORCE GLOBAL PZ -100.
LOADING 2 ' DEAD LOAD '
ELEMENT LOADS
1 TO 16 BODY FORCE GLOBAL BZ -490.
LOADING 3 ' 50 DEGREE TEMP CHANGE '
JOINT TEMPERATURE
1 TO 65 CHANGE 50.
STIFFNESS ANALYSIS REDUCE BAND
PLOT SAVE 'PLT1'
LIST REACTIONS,DISPLACEMENTS,STRESSES,PRINCIPAL STRESS ALL
LIST ELEMENT FORCES ALL
FINISH
                                 ND OF FILE
??
```

Figure D16. Data file for GTSTRUDL thin plate problem analysis and plotting

```
STRUDL ' THICK PLATE '
UNITS FEET
TYPE PLATE BENDING
GENERATE 9 JOINTS ID 1,1 X 0,1.25 Y 0,0
MODIFY 4 ID 14 Y 2.5
GENERATE 5 JOINTS ID 10,1 X 0,2.5 Y 1.25,0
MODIFY 3 ID 14 Y 2.5
GENERATE 4 ELEMENTS ID 1,1 FROM 1,2 TO 3,2 TO 17,2 TO 15,2 -
 TO 2,2 TO 11,1 TO 16,2 TO 10,1
MODIFY 3 ID 4 FROM 14 TO 14 TO 14 TO 14 TO 14 TO 14 TO 14 TO 14
STATUS SUPPORT 1 TO 9,57 TO 65,10 TO 52 BY 14,15 TO 43 BY 14, -
 14 TO 56 BY 14, 23 TO 51 BY 14
JOINT RELEASES
3 TO 8 MOMENT Y
10 TO 52 BY 14,15 TO 43 BY 14 MOMENT X
1 TO 8,10 TO 52 BY 14,15 TO 43 BY 14 FORCE Z
ELEMENTS 1 TO 16 PROPERTIES TYPE 'IPBQQ' THICK 5.
CONSTANTS
E 4.176E9 ALL
POI .27 ALL
CTE 6.6E-6 ALL
LOADING 1 '100PSF UNIFORM LOAD'
ELEMENT LOADS
1 TO 16 SURFACE FORCES GLOBAL PZ -100.
LOADING 2 ' DEAD LOAD '
ELEMENT LOADS
1 TO 16 BODY FORCE GLOBAL BZ -490.
LOADING 3 ' 50 DEGREE TEMP CHANGE '
JOINT TEMPERATURE
1 TO 65 CHANGE 50.
STIFFNESS ANALYSIS REDUCE BAND
PLOT SAVE 'PLT1'
LIST REACTIONS,DISPLACEMENTS,STRESSES,PRINCIPAL STRESS ALL
LIST ELEMENT FORCES ALL
FINISH
                                 ND OF FILE
??
```

Figure D17. Data file for GTSTRUDL thick plate problem analysis and plotting

```
STRUDL ' MODERATELY THICK PLATE '
UNITS FEET
TYPE PLATE BENDING
GENERATE 9 JOINTS ID 1,1 X 0,1.25 Y 0.0
MODIFY 4 ID 14 Y 2.5
GENERATE 5 JOINTS ID 10,1 X 0,2.5 Y 1.25,0
MODIFY 3 ID 14 Y 2.5
GENERATE 4 ELEMENTS ID 1,1 FROM 1,2 TO 3,2 TO 17,2 TO 15,2 -
 TO 2,2 TO 11,1 TO 16,2 TO 10,1
MODIFY 3 ID 4 FROM 14 TO 14 TO 14 TO 14 TO 14 TO 14 TO 14 TO 14
STATUS SUPPORT 1 TO 9,57 TO 65,10 TO 52 BY 14,15 TO 43 BY 14, -
 14 TO 56 BY 14, 23 TO 51 BY 14
JOINT RELEASES
2 TO 8 MOMENT Y
10 TO 52 BY 14,15 TO 43 BY 14 MOMENT X
1 TO 8,10 TO 52 BY 14,15 TO 43 BY 14 FORCE Z
ELEMENTS 1 TO 16 PROPERTIES TYPE 'IPBQQ' THICK 1.5
CONSTANTS
E 4.176E5 ALL
POI .27 ALL
CTE 6.6E-6 ALL
LOADING 1 '100PSF UNIFORM LOAD'
ELEMENT LOADS
1 TO 16 SURFACE FORCES GLOBAL PZ -100.
LOADING 2 ' DEAD LOAD '
ELEMENT LOADS
1 TO 16 BODY FORCE GLOBAL BZ -490.
LOADING 3 ' 50 DEGREE TEMP CHANGE '
JOINT TEMPERATURE
1 TO 65 CHANGE 50.
STIFFNESS ANALYSIS REDUCE BAND
PLOT SAVE 'PLT1'
LIST REACTIONS,DISPLACEMENTS,STRESSES,PRINCIPAL STRESS ALL
LIST ELEMENT FORCES ALL
FINISH
                                   .ND OF FILE
??
```

Figure D18. Data file for GTSTRUDL moderately thick plate problem analysis and plotting

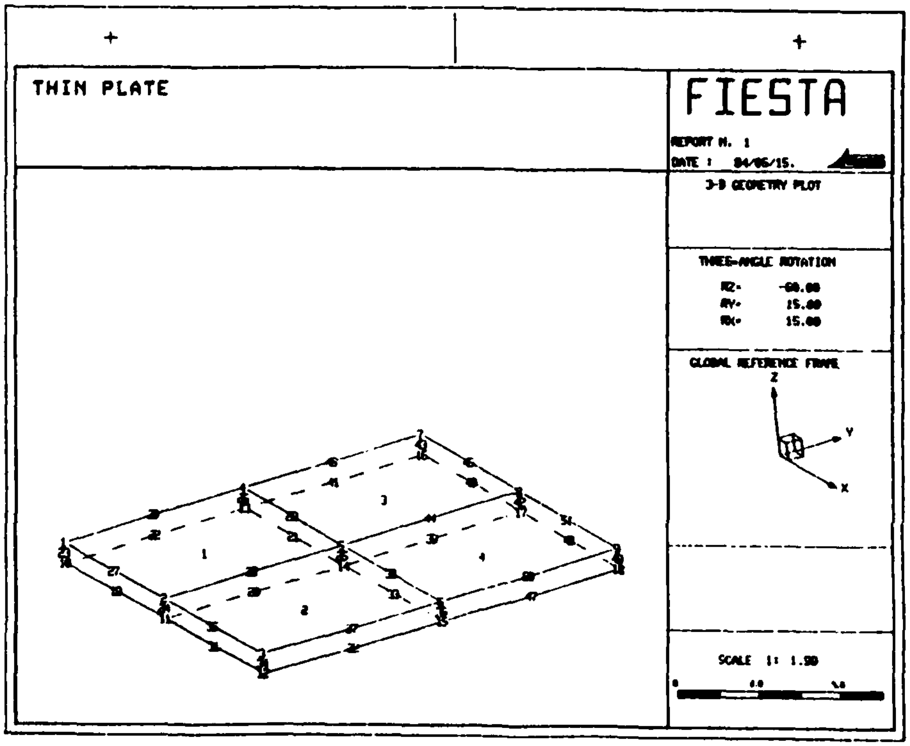


Figure D19. FIESTA thin plate geometry with node and element numbering

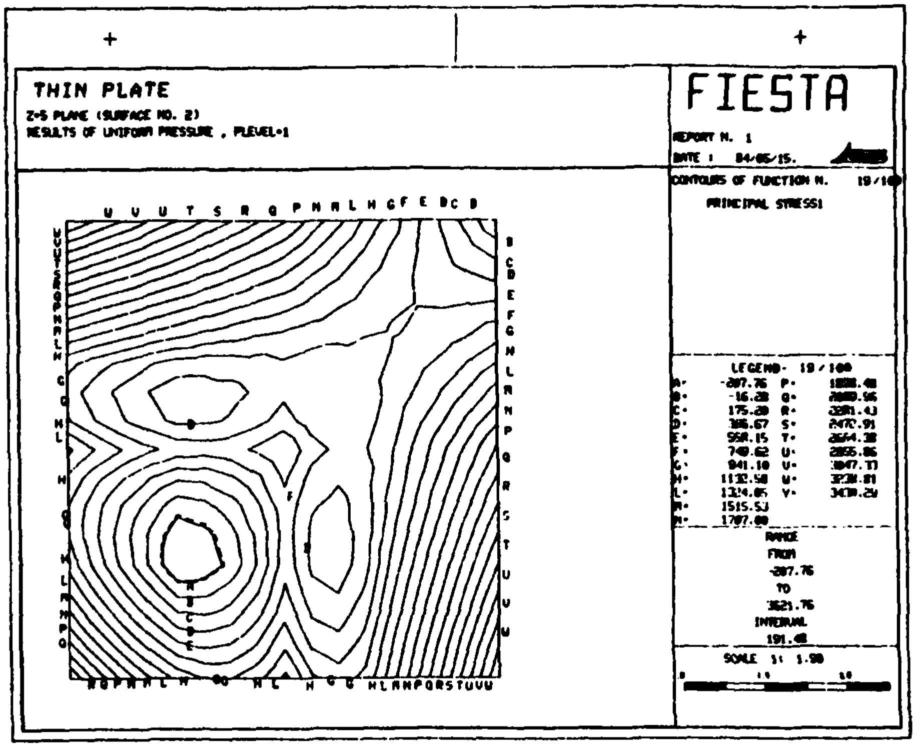


Figure D20. X-direction principal stress contours for P-level 1 analysis with uniform pressure loading, thin plate

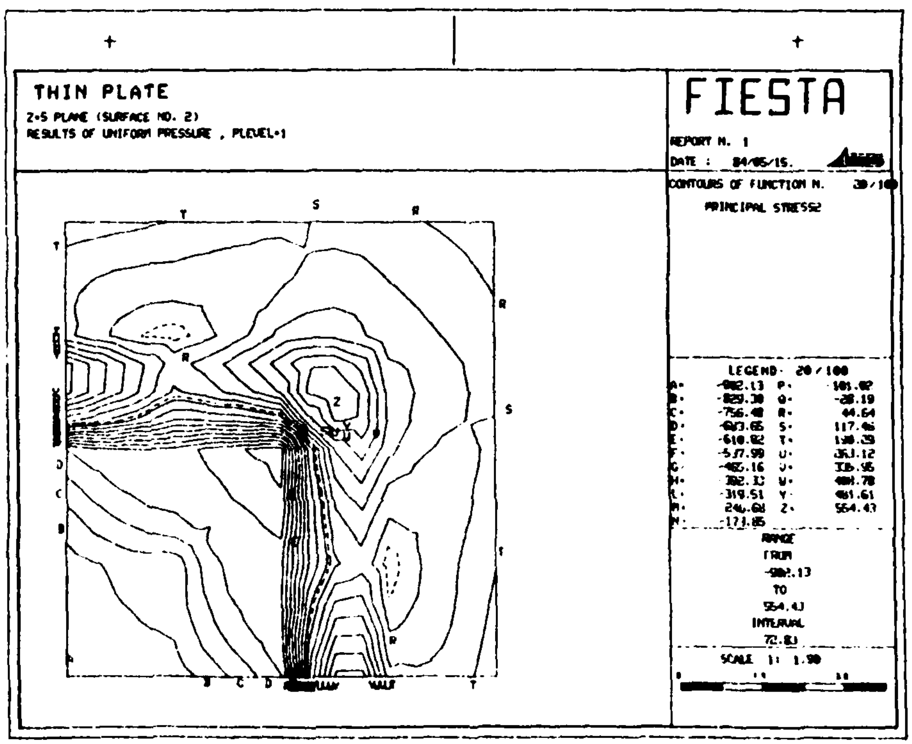


Figure D21. Y- direction principal stress contours for P-level 1 analysis with uniform pressure loading, thin plate

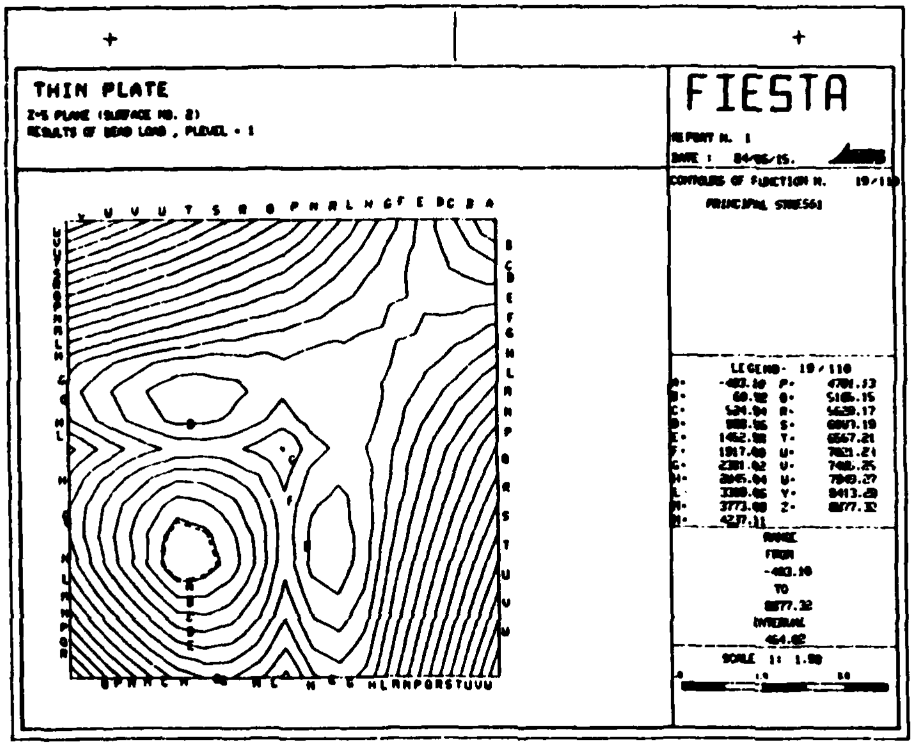


Figure D22. X-direction principal stress contours for P-level 1 analysis with dead loading, thin plate

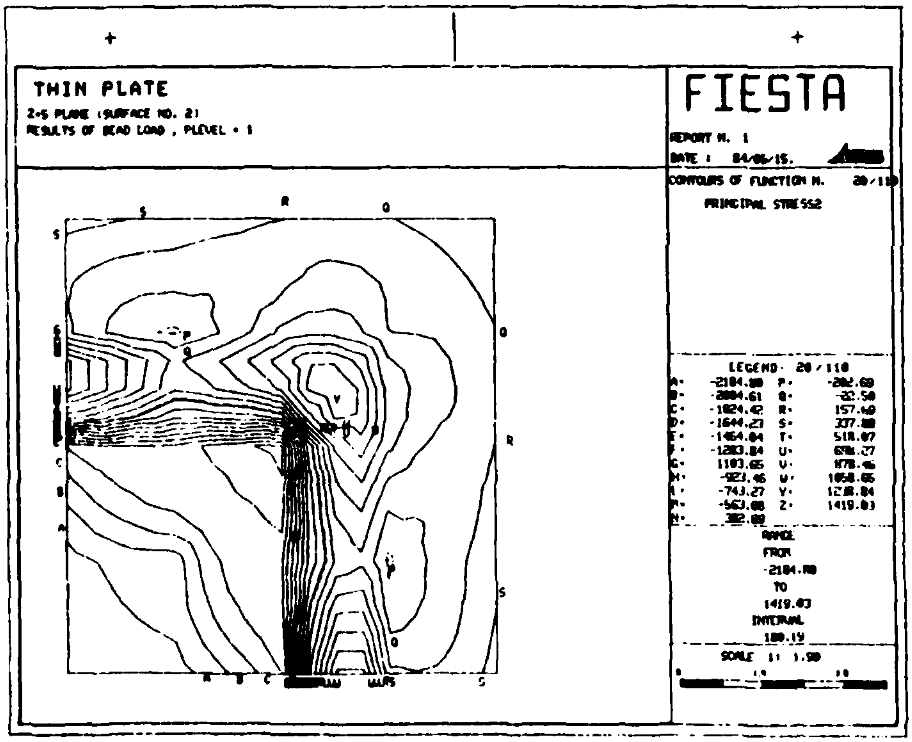


Figure D23. Y-direction principal stress contours for P-level 1 analysis with dead loading, thin plate

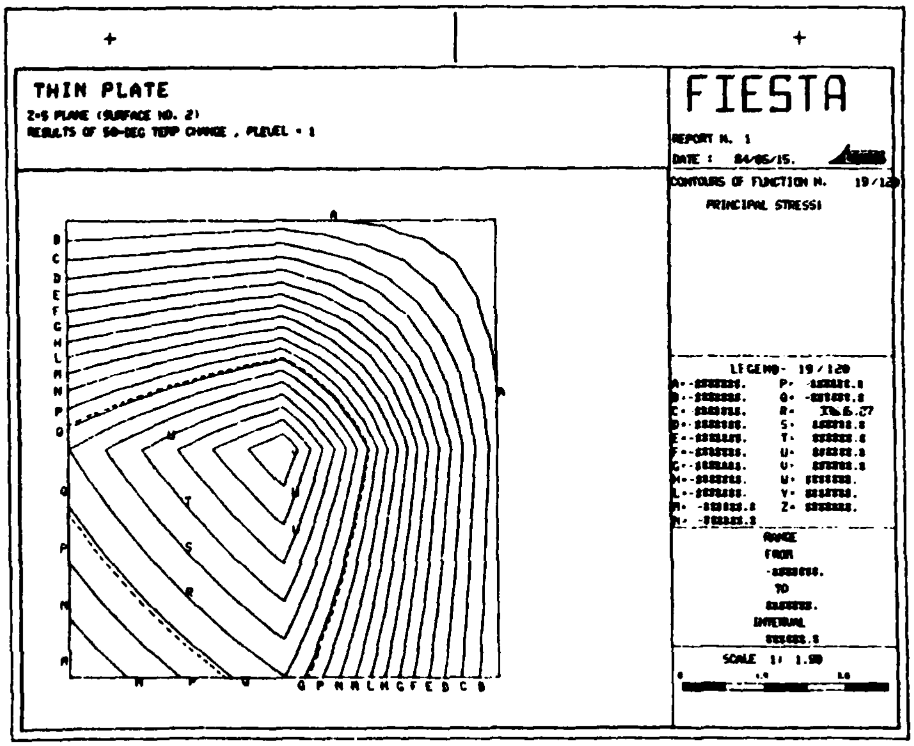


Figure D24. X-direction principal stress contours for P-level 1 analysis with temperature loading, thin plate

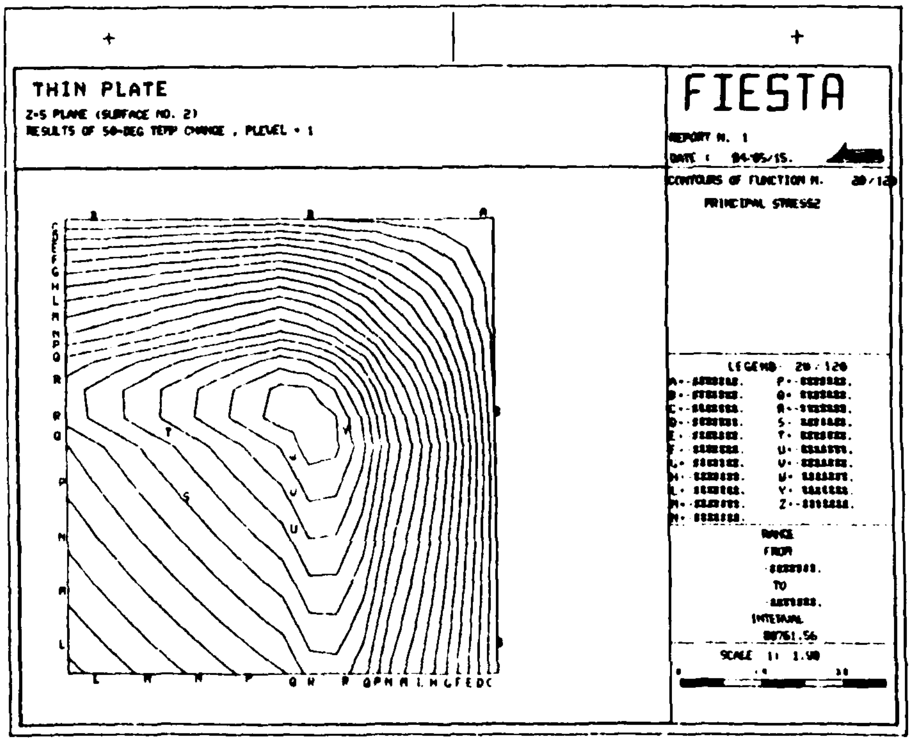


Figure D25. Y-direction principal stress contours for P-level 1 analysis with temperature loading, thin plate

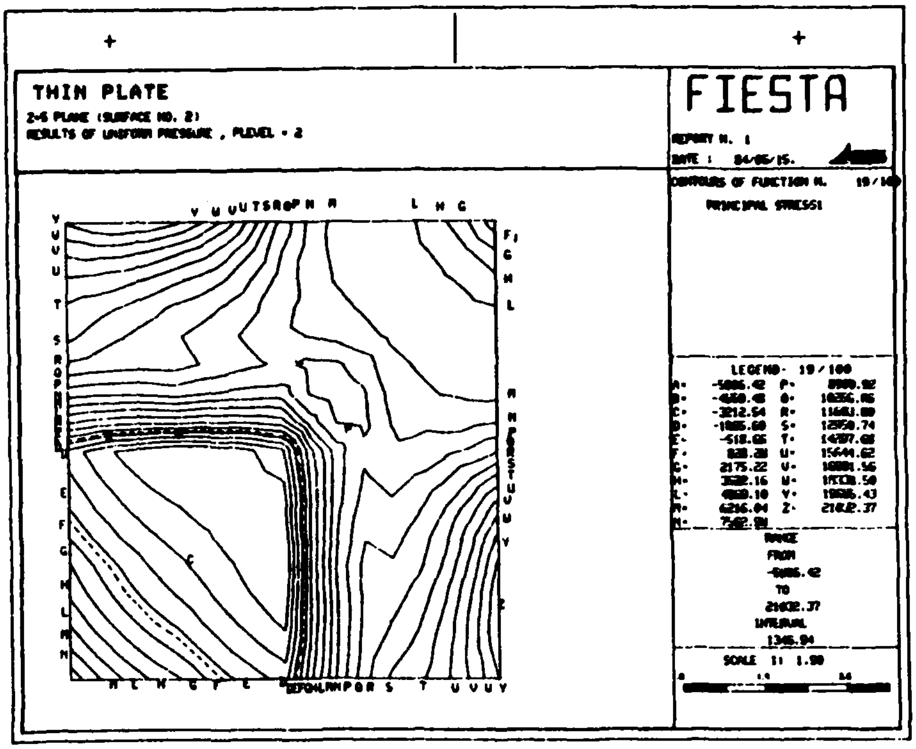


Figure D26. X-direction principal stress contours for P-level 2 analysis with uniform pressure loading, thin plate

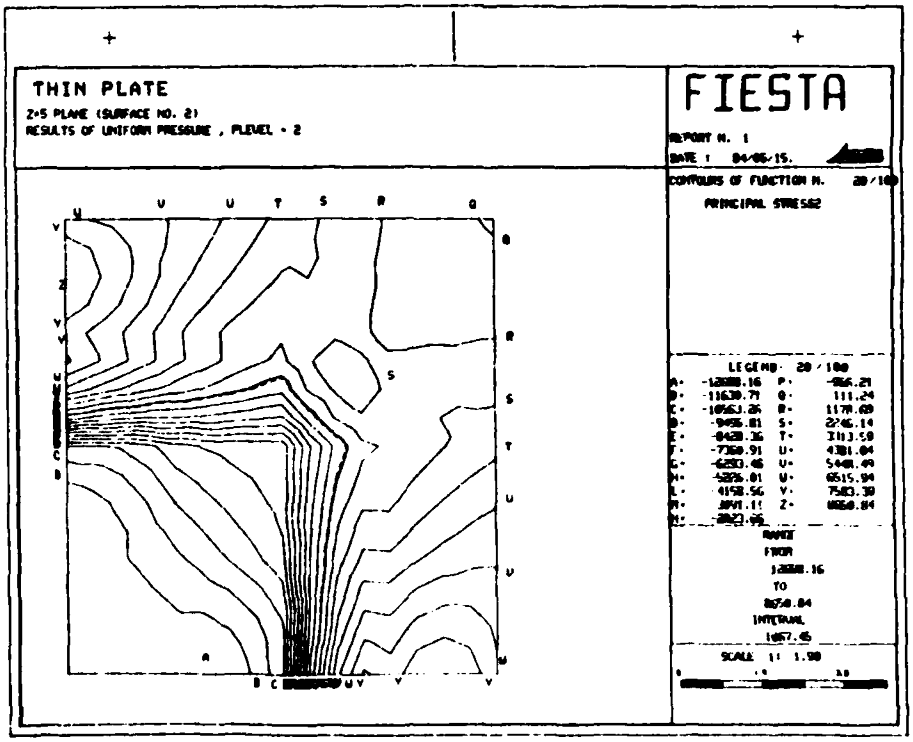


Figure D27. Y-direction principal stress contours for P-level 2 analysis with uniform pressure loading, thin plate

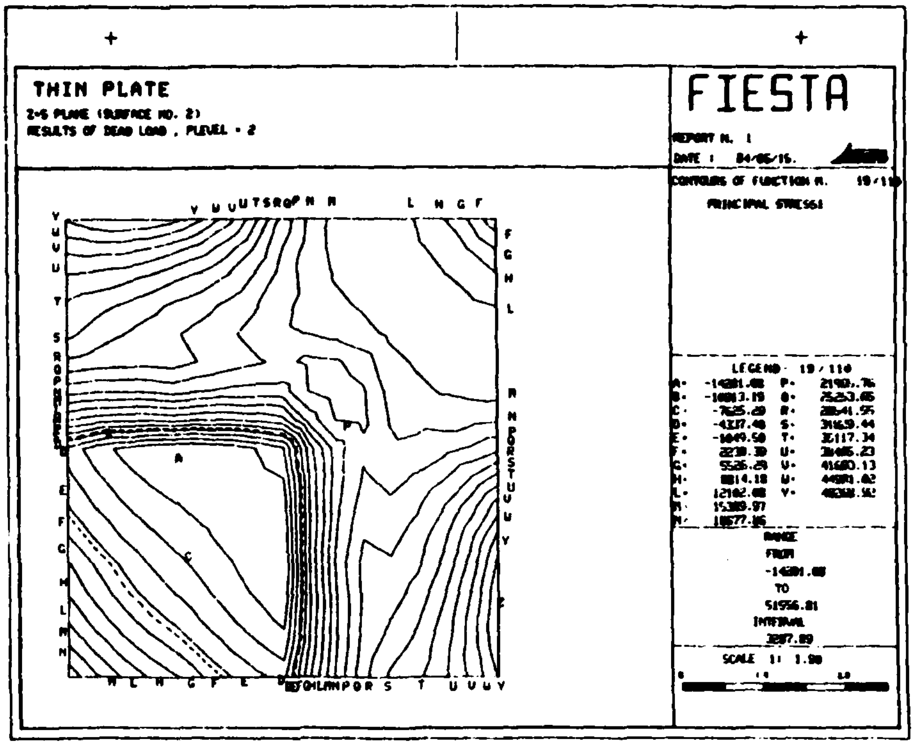


Figure D28. X-direction principal stress contours for P-level 2 analysis with dead loading, thin plate

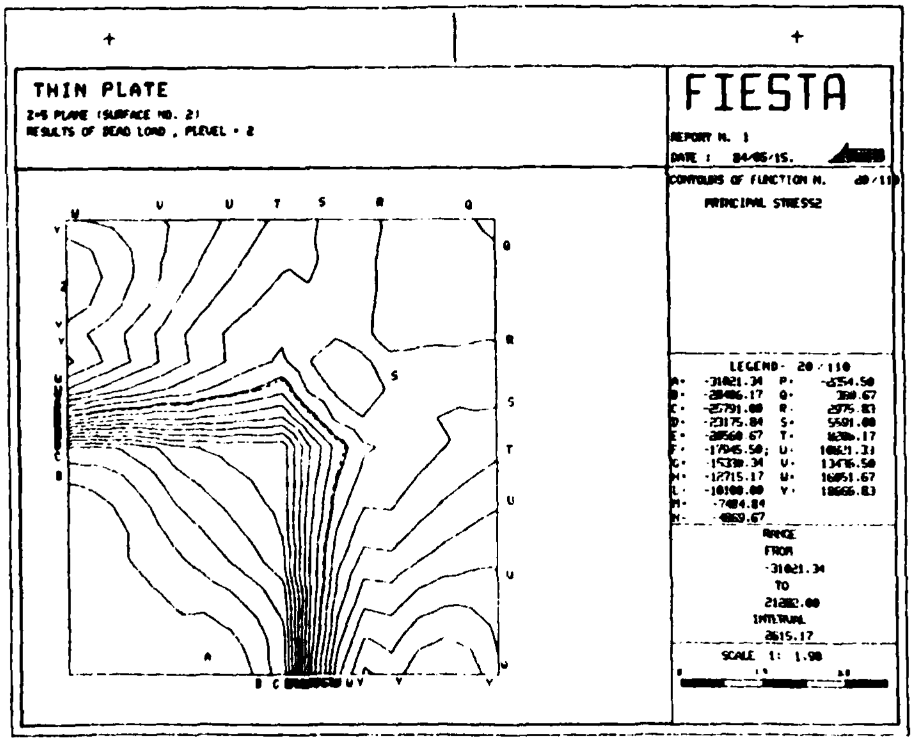


Figure D29. Y-direction principal stress contours for P-level 2 analysis with dead loading, thin plate

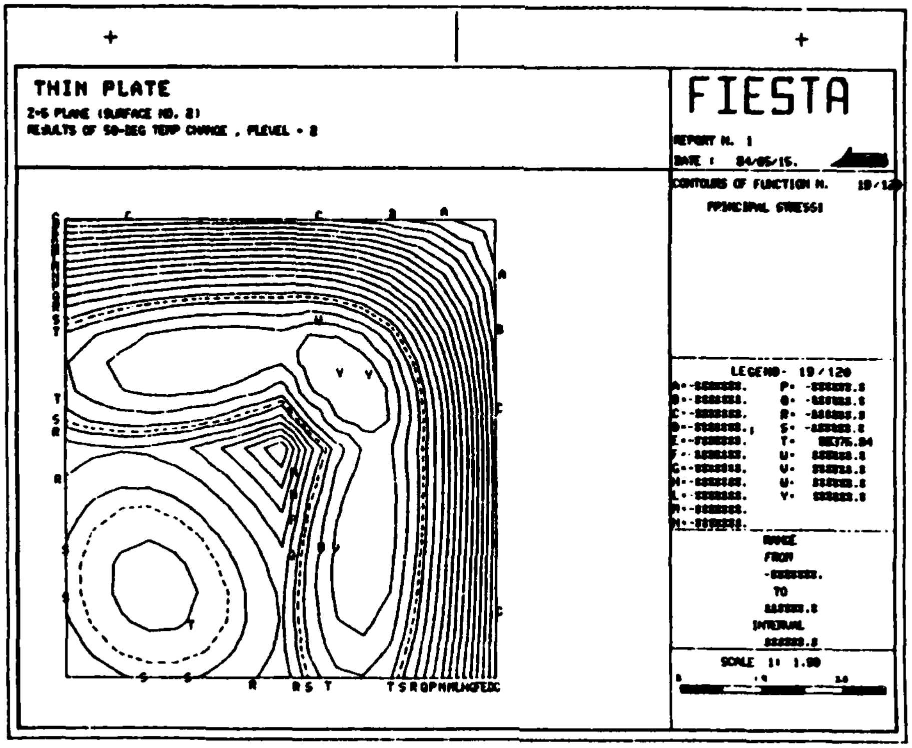


Figure D30. X-direction principal stress contours for P-level 2 analysis with temperature loading, thin plate

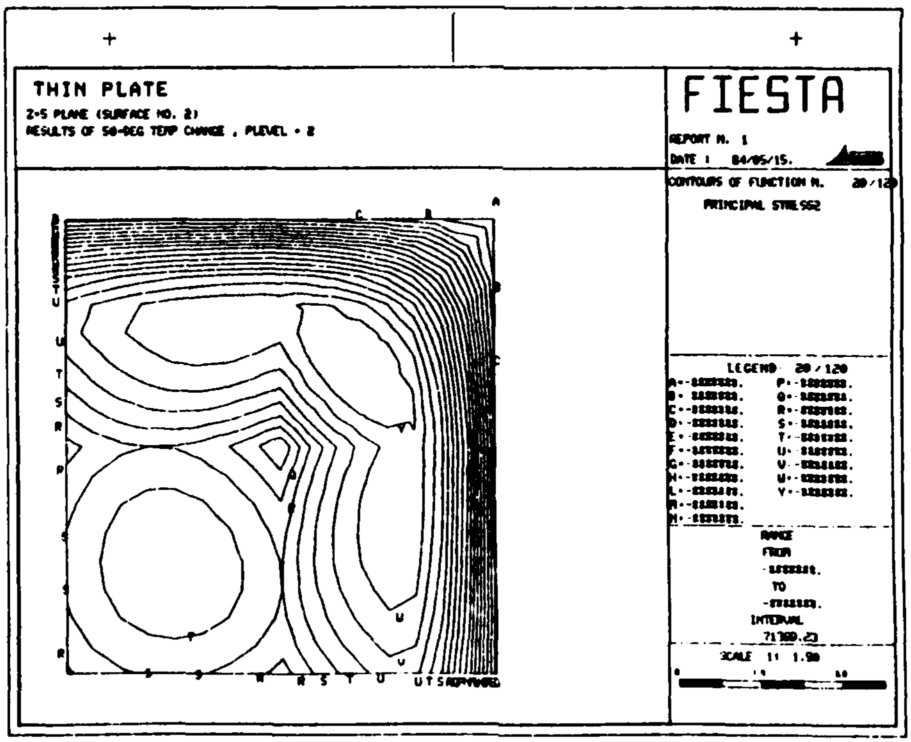


Figure D31. Y-direction principal stress contours for P-level 2 analysis with temperature loading, thin plate

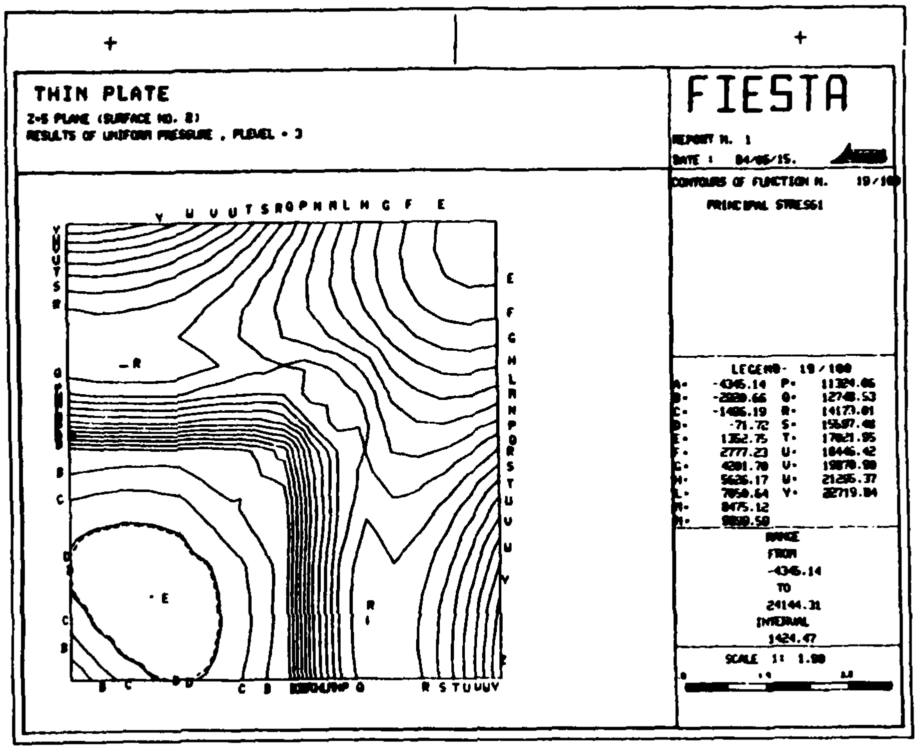


Figure D32. X-direction principal stress contours for P-level 3 analysis with uniform pressure loading, thin plate

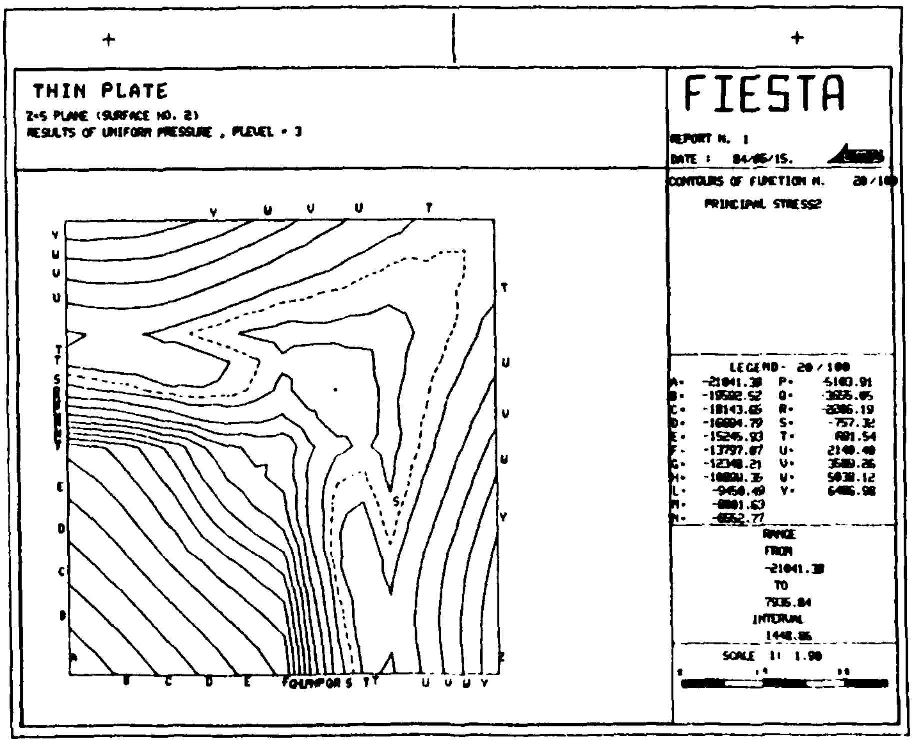


Figure D33. Y-direction principal stress contours for P-level 3 analysis with uniform pressure loading, thin plate

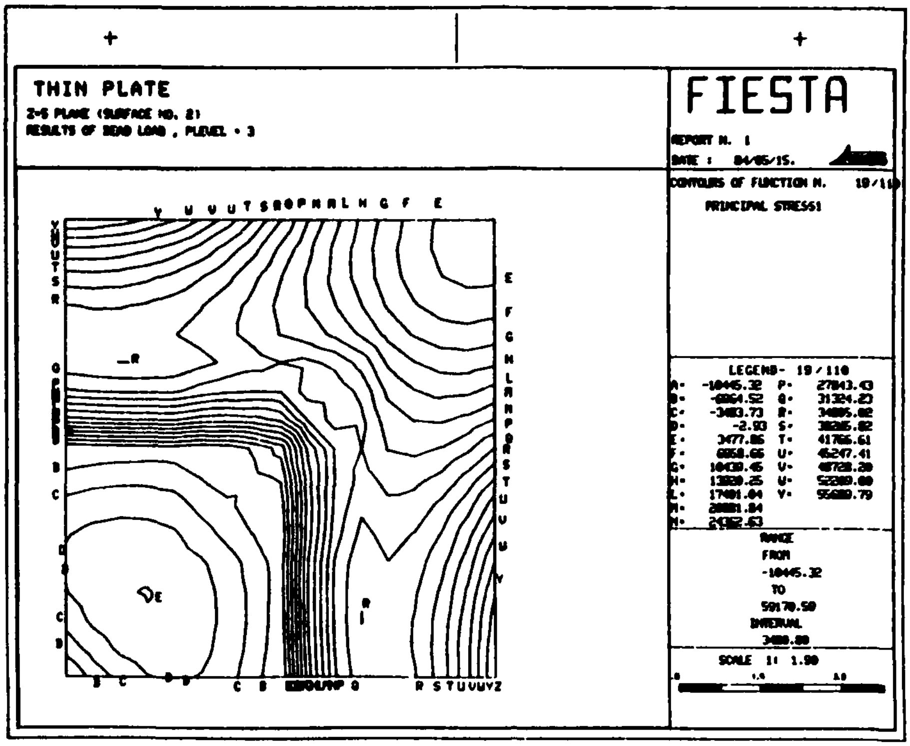


Figure D34. X-direction principal stress contours for P-level 3 analysis with dead loading, thin plate

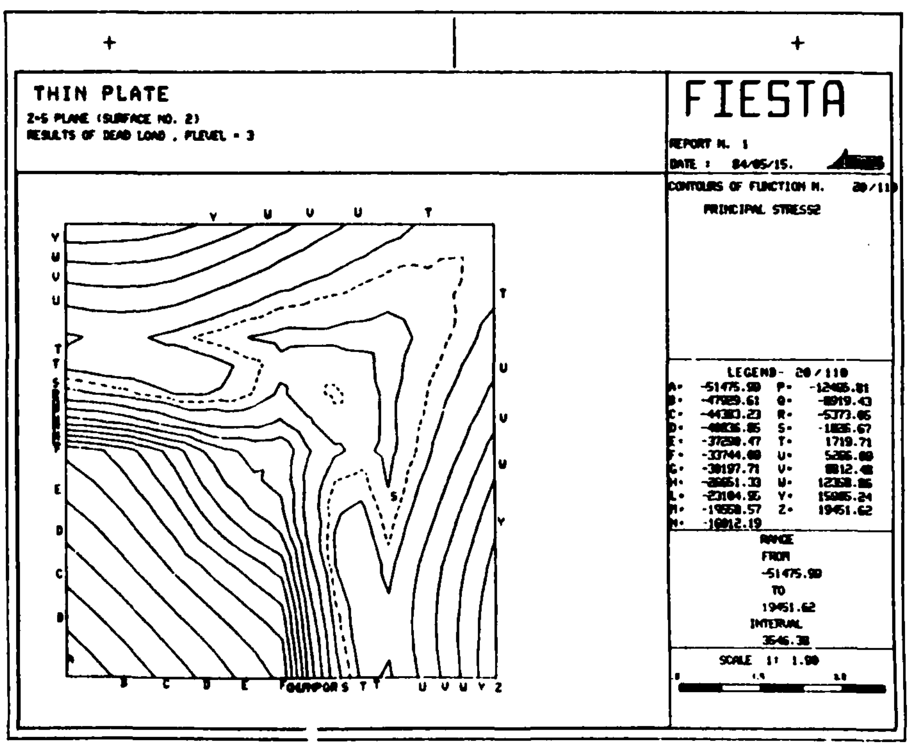


Figure D35. Y-direction principal stress contours for P-level 3 analysis with dead loading, thin plate

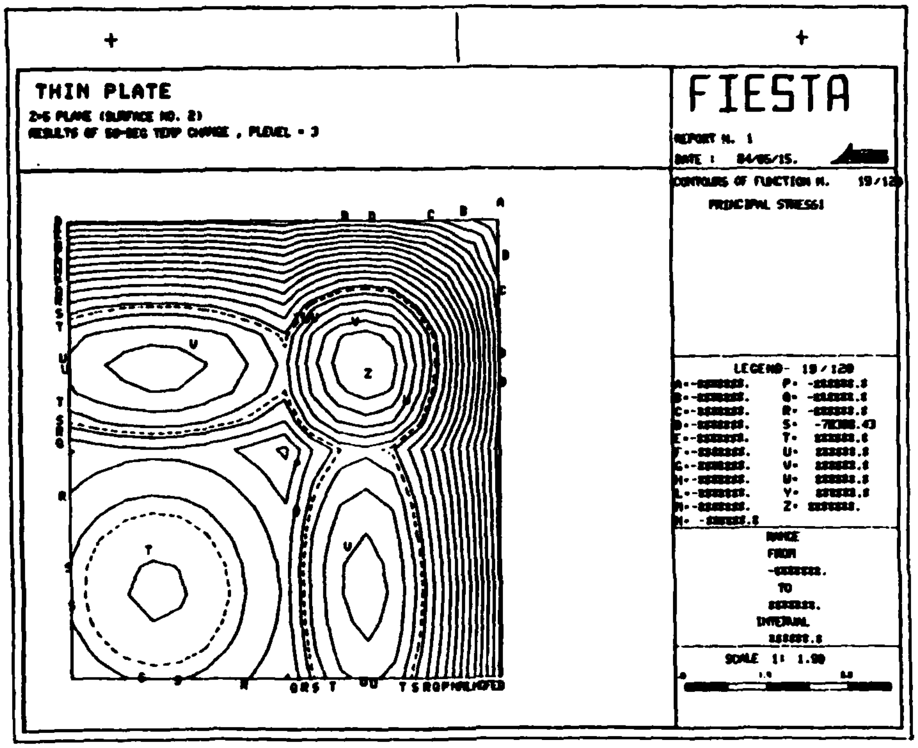


Figure D36. X-direction principal stress contours for P-level 3 analysis with temperature loading, thin plate

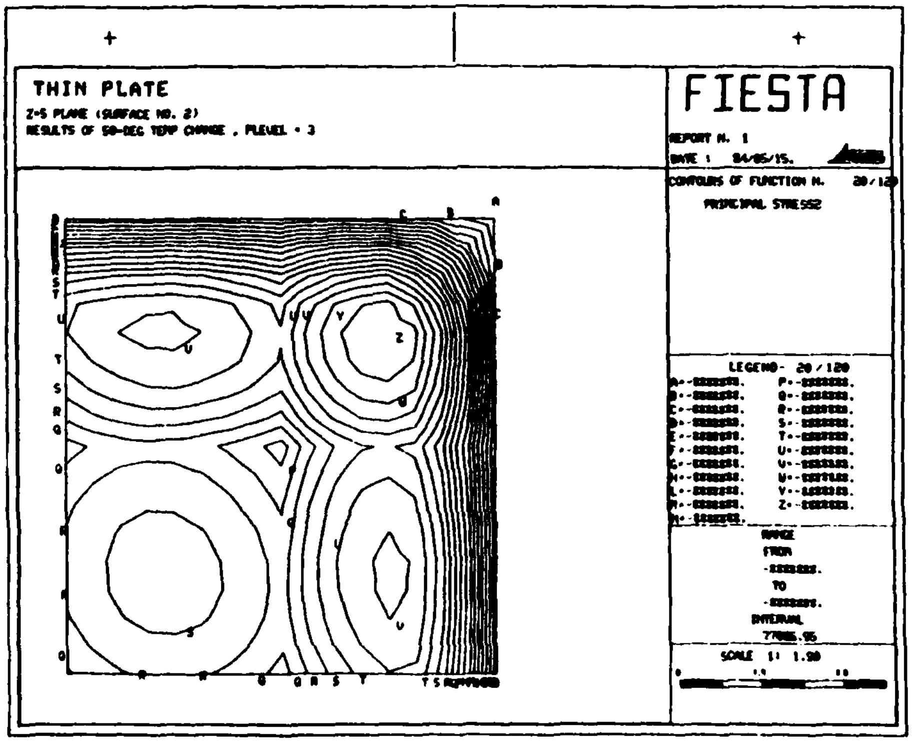


Figure D37. Y-direction principal stress contours for P-level 3 analysis with temperature loading, thin plate

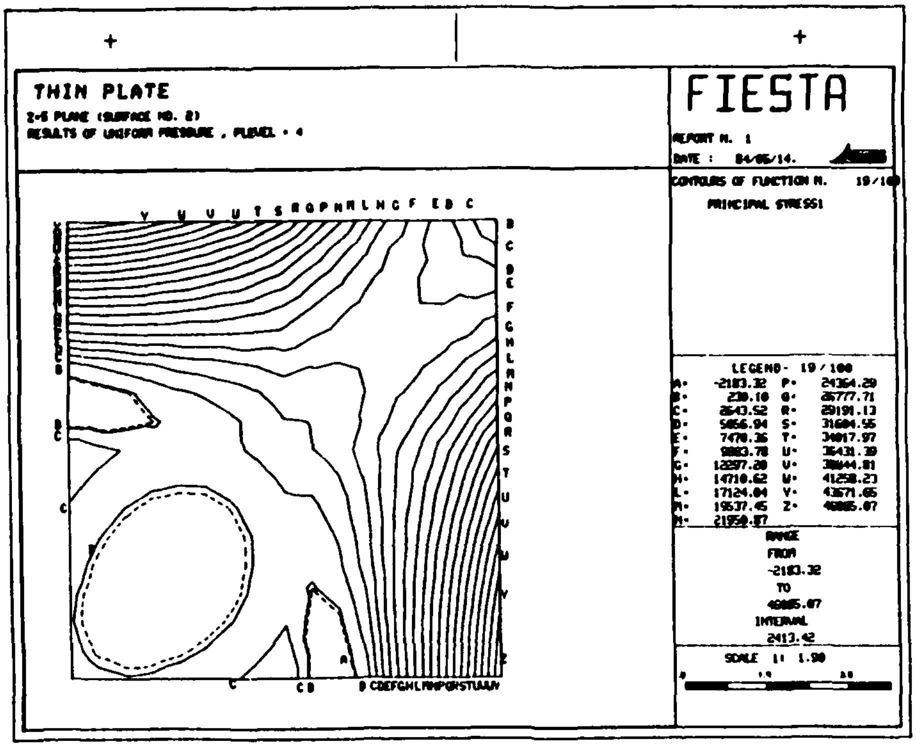


Figure D38. X-direction principal stress contours for P-level 4 analysis with uniform pressure loading, thin plate

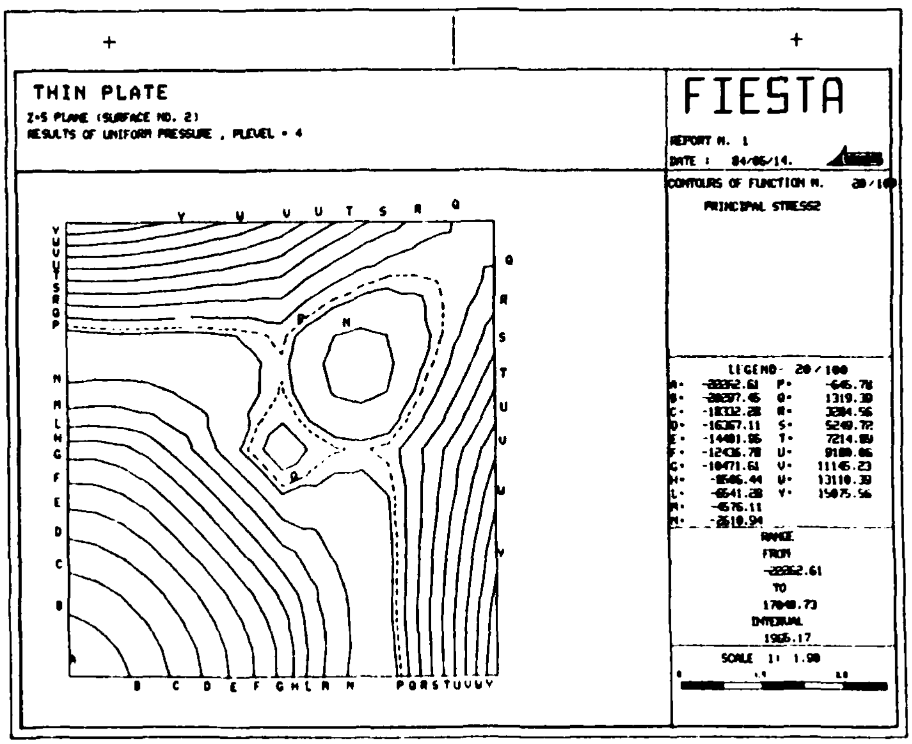


Figure D39. Y-direction principal stress contours for P-level 4 analysis with uniform pressure loading, thin plate

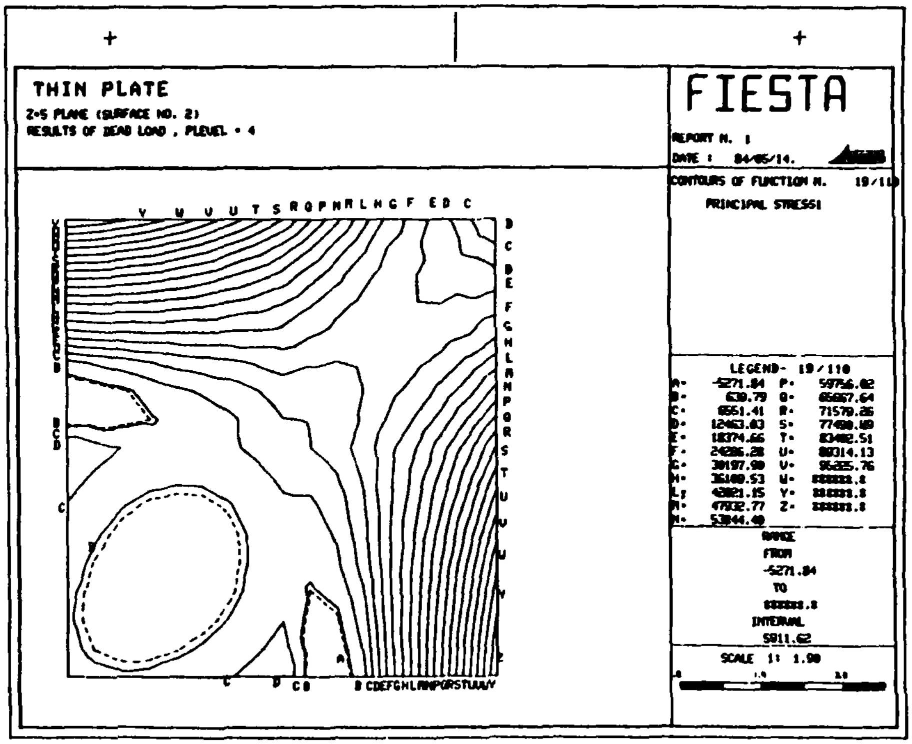


Figure D40. X-direction principal stress contours for P-level 4 analysis with dead loading, thin plate

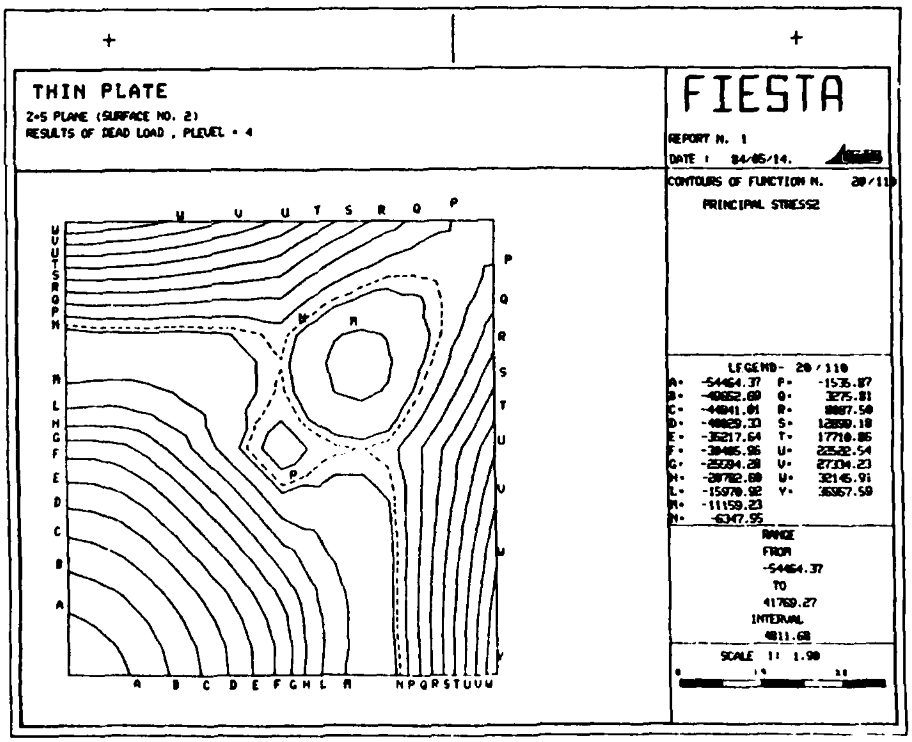


Figure D41. Y-direction principal stress contours for P-level 4 analysis with dead loading, thin plate

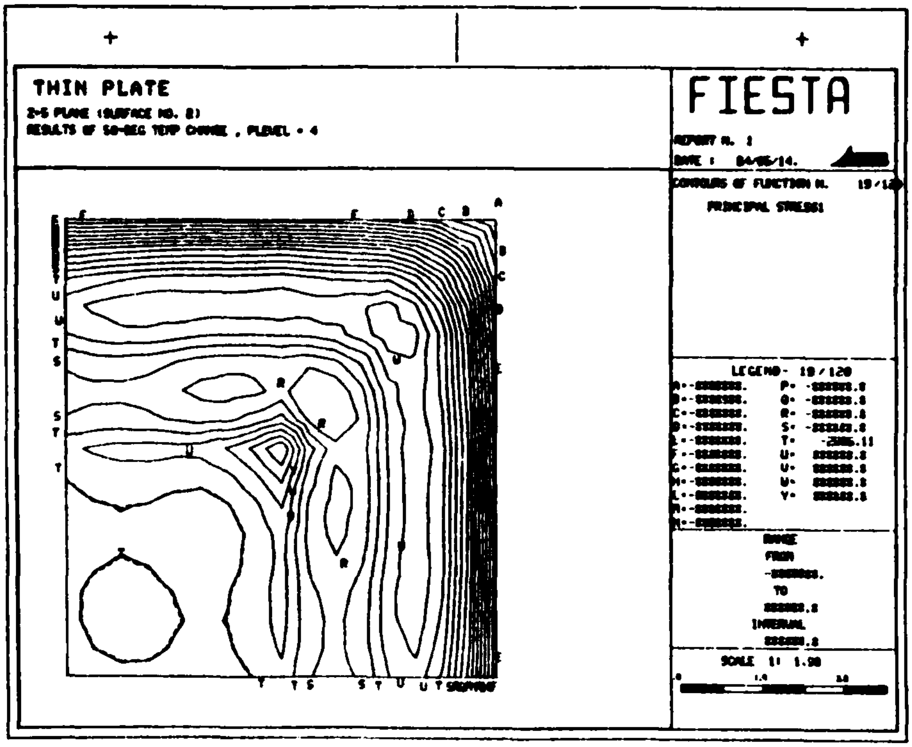


Figure D42. X-direction principal stress contours for P-level 4 analysis with temperature loading, thin plate

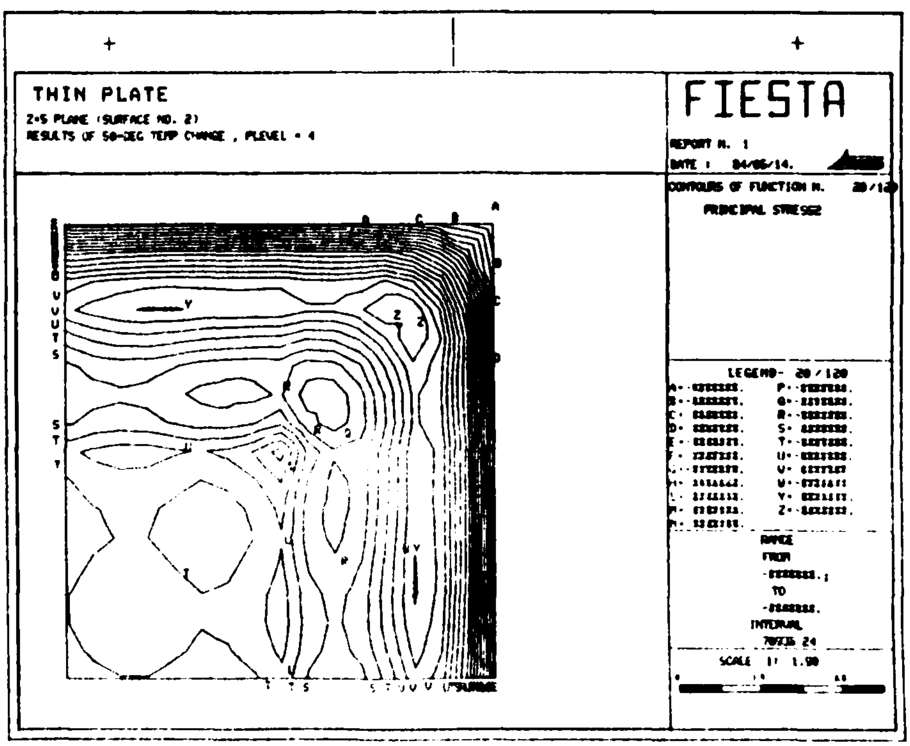


Figure D43. Y-direction principal stress contours for P-level 4 analysis with temperature loading, thin plate

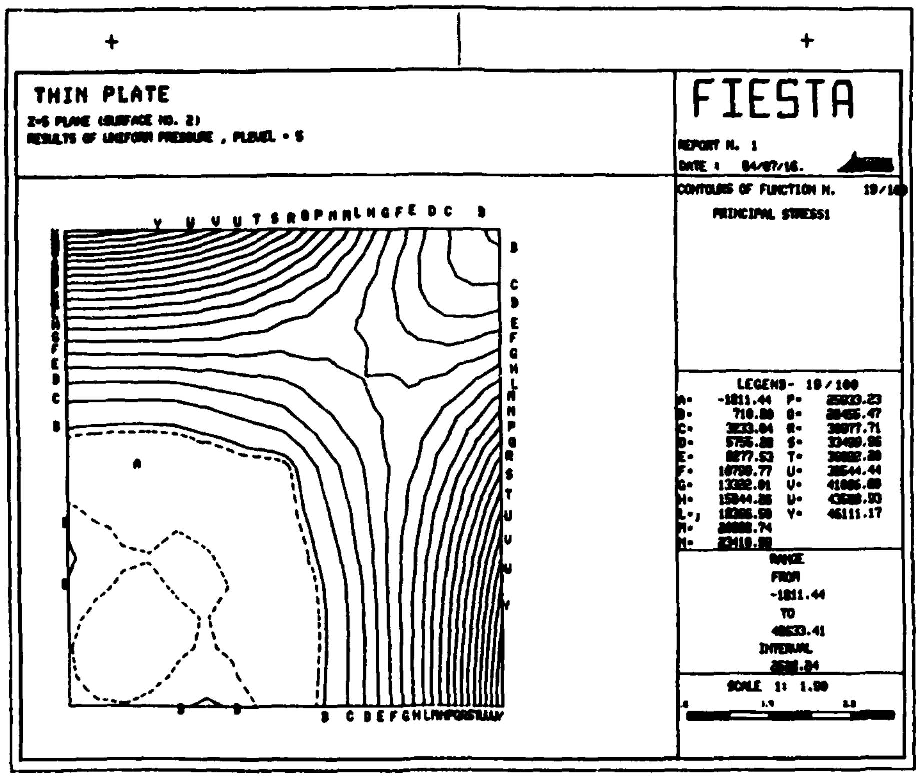


Figure D44. X-direction principal stress contours for P-level 5 analysis with uniform pressure loading, thin plate

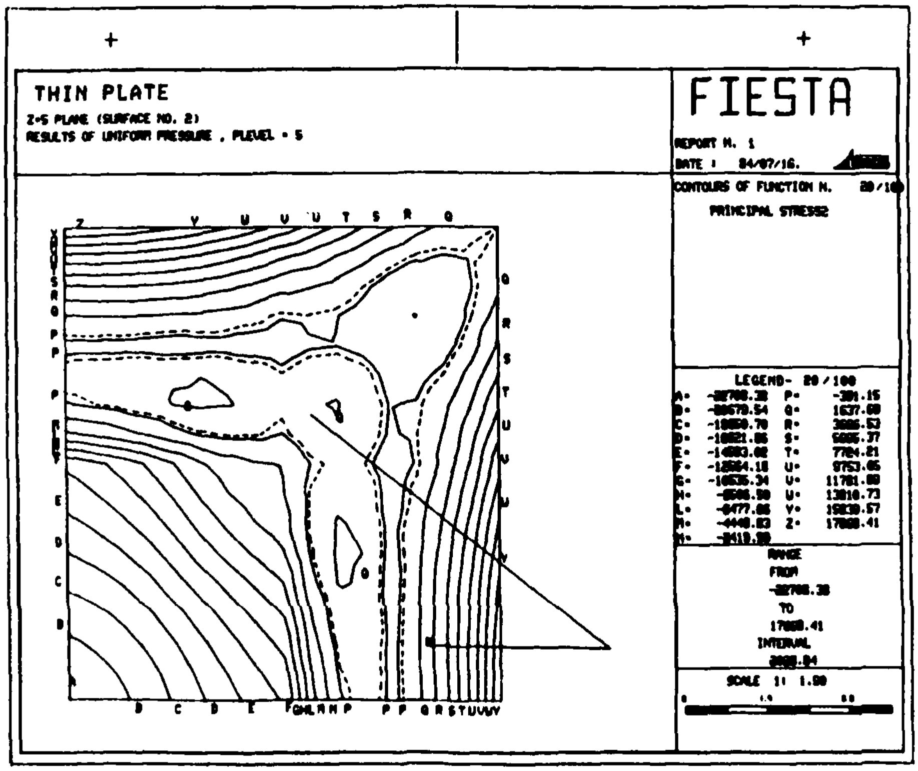


Figure D45. Y-direction principal stress contours for P-level 5 analysis with uniform pressure loading, thin plate

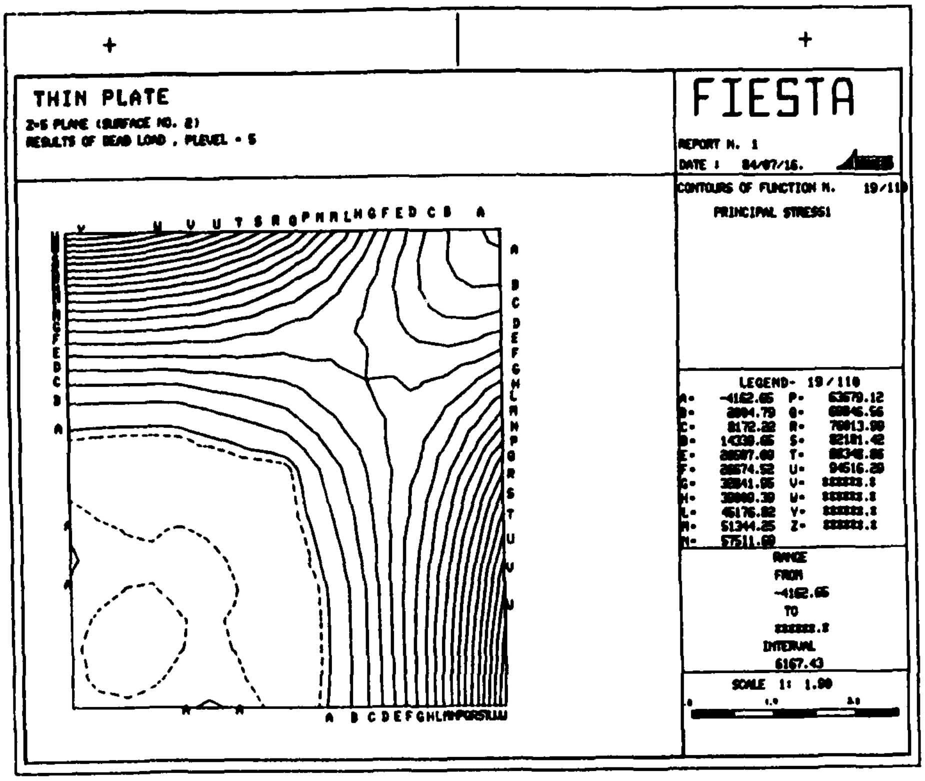


Figure D46. X-direction principal stress contours for P-level 5 analysis with dead loading, thin plate

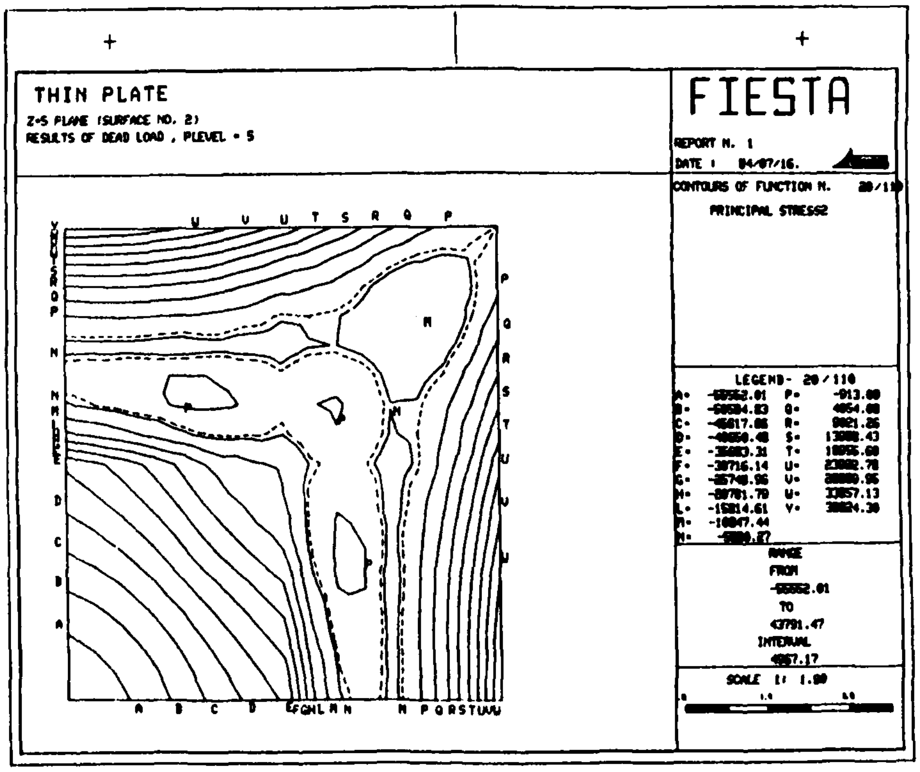


Figure D47. Y-direction principal stress contours for P-level 5 analysis with dead loading, thin plate

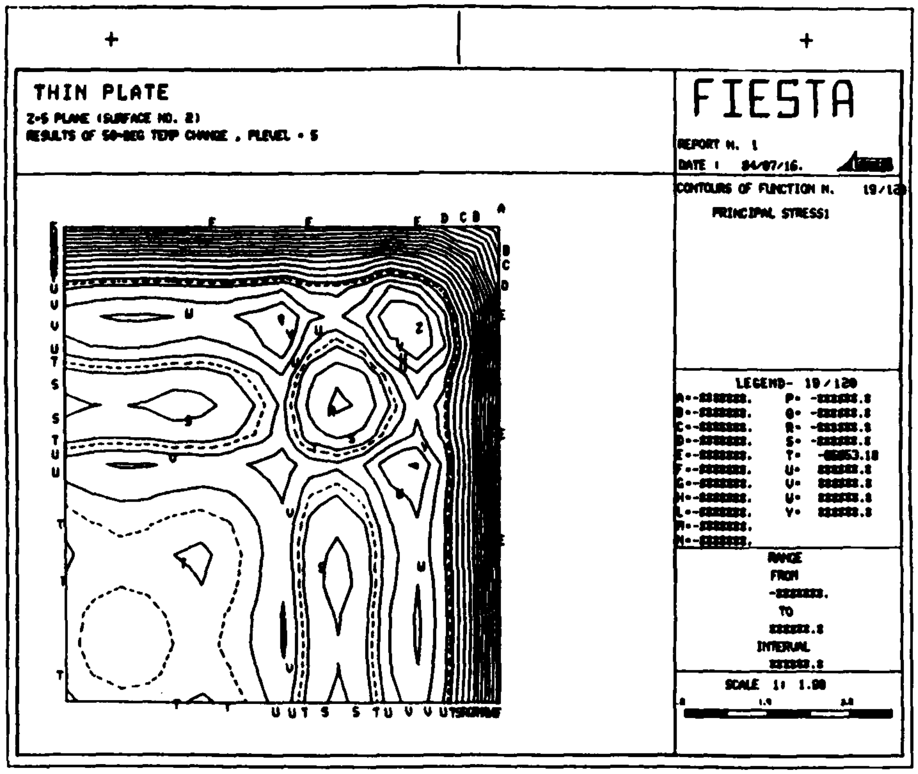


Figure D48. X-direction principal stress contours for P-level 5 analysis with temperature loading, thin plate

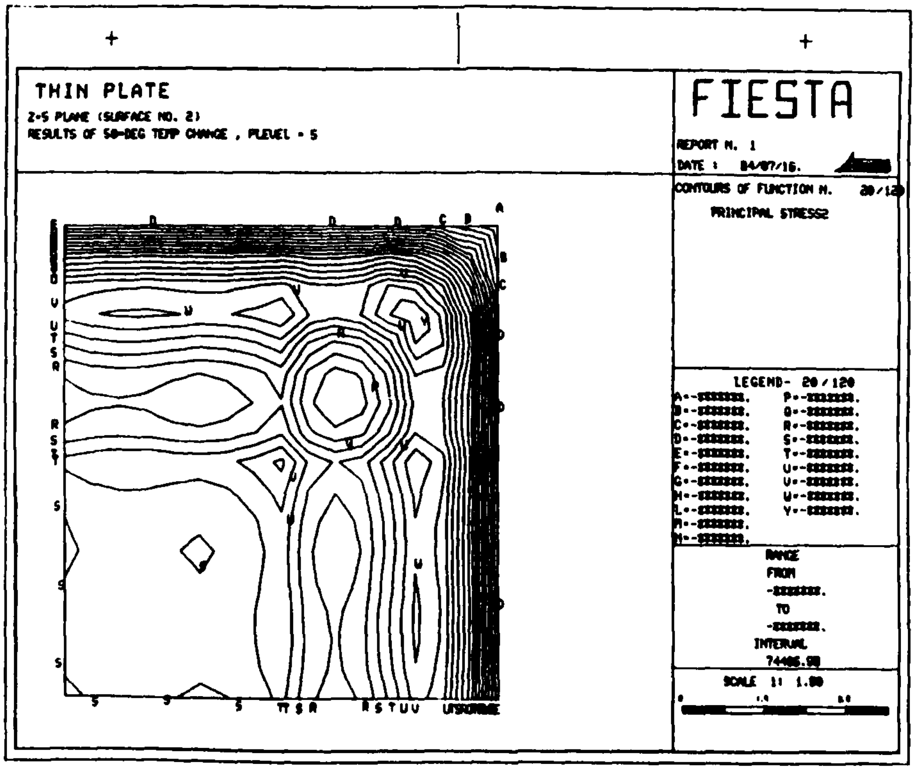


Figure D49. Y-direction principal stress contours for P-level 5 analysis with temperature loading, thin plate

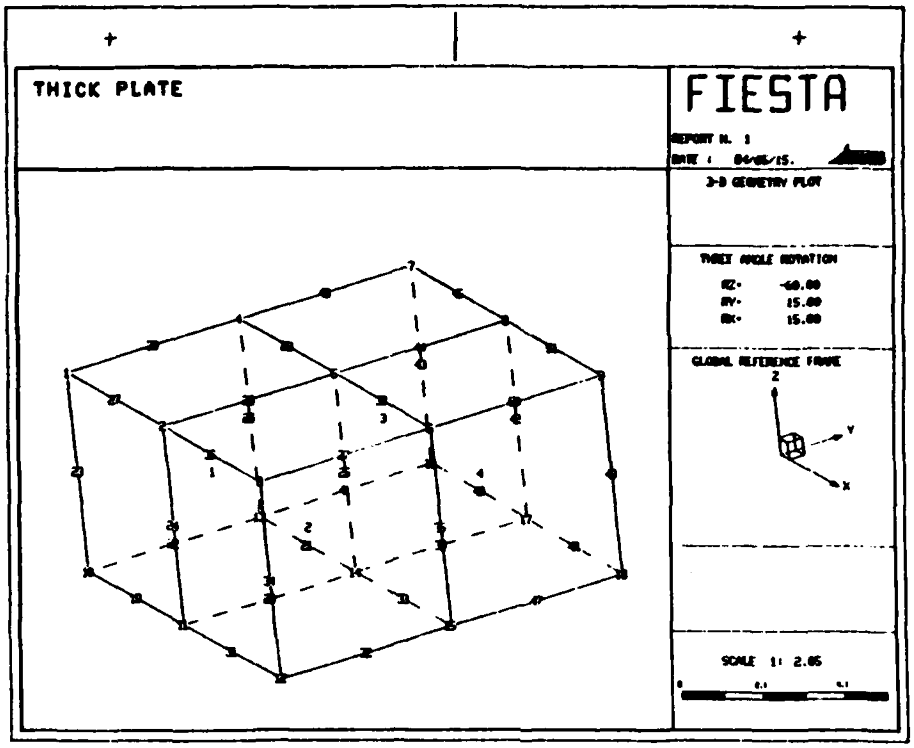


Figure D50. FIESTA thick plate geometry with node and element numbering

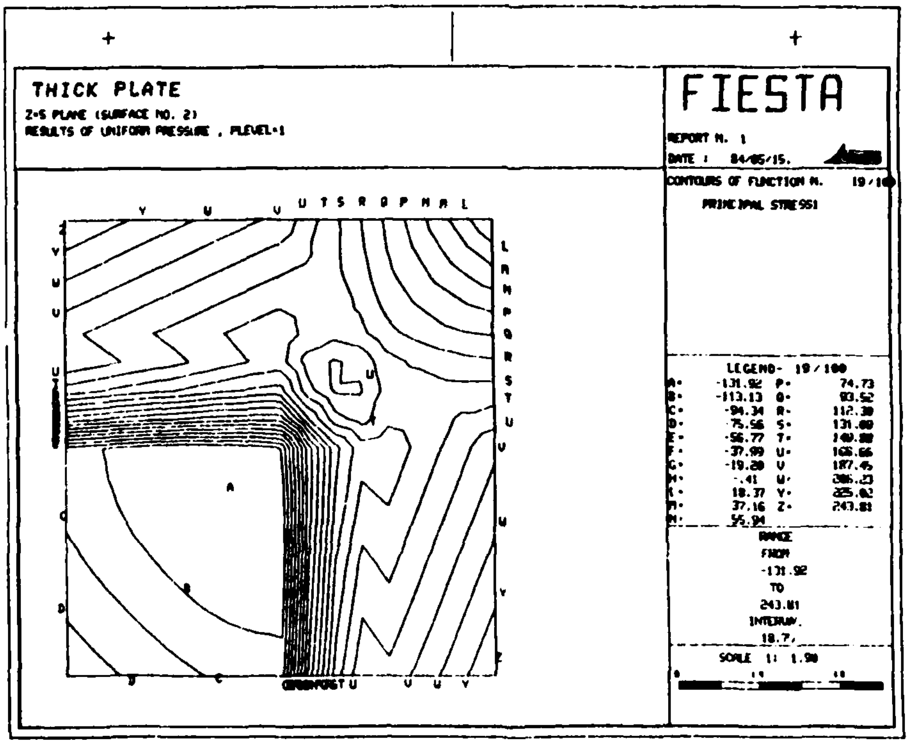


Figure 51. X-direction principal stress contours for P-level 1 analysis with uniform pressure loading, thick plate

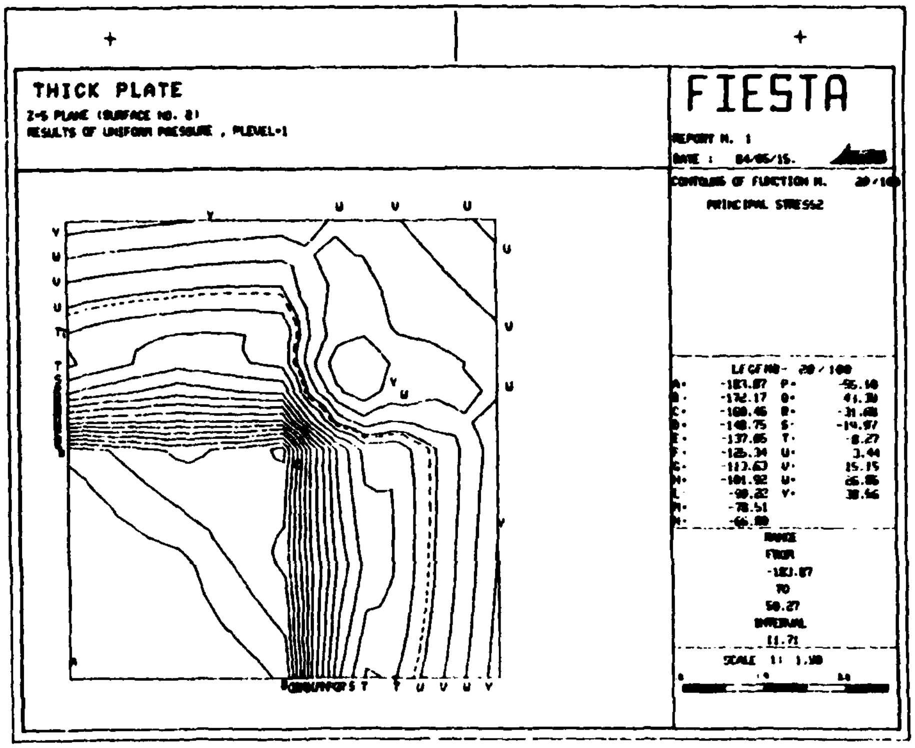


Figure D52. Y-direction principal stress contours for P-level 1 analysis with uniform pressure loading, thick plate

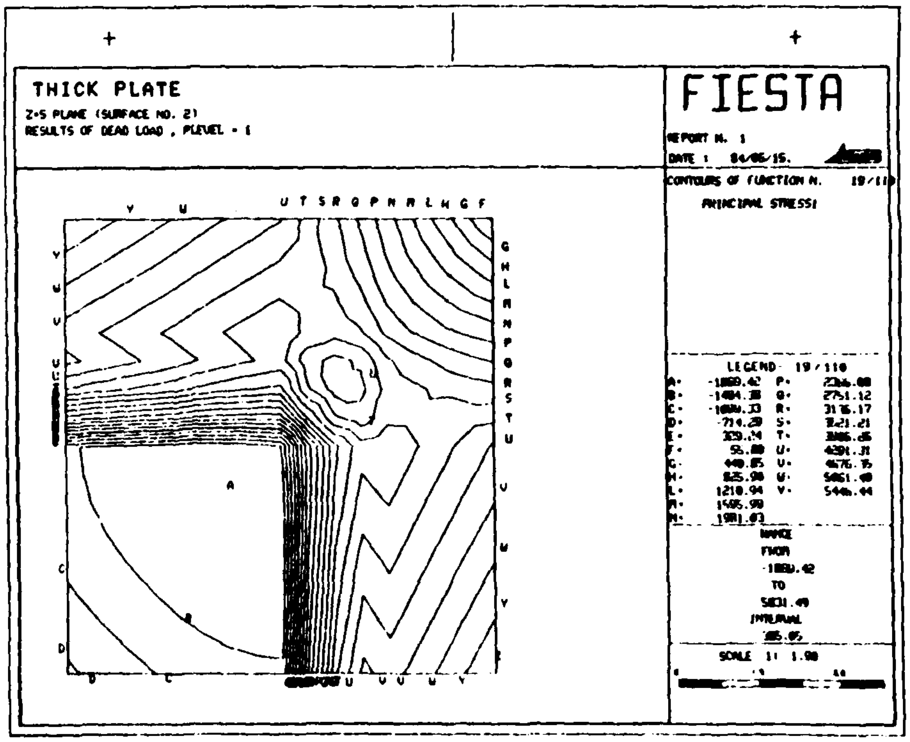


Figure D53. X-direction stress contours for P-level 1 analysis with dead loading, thick plate

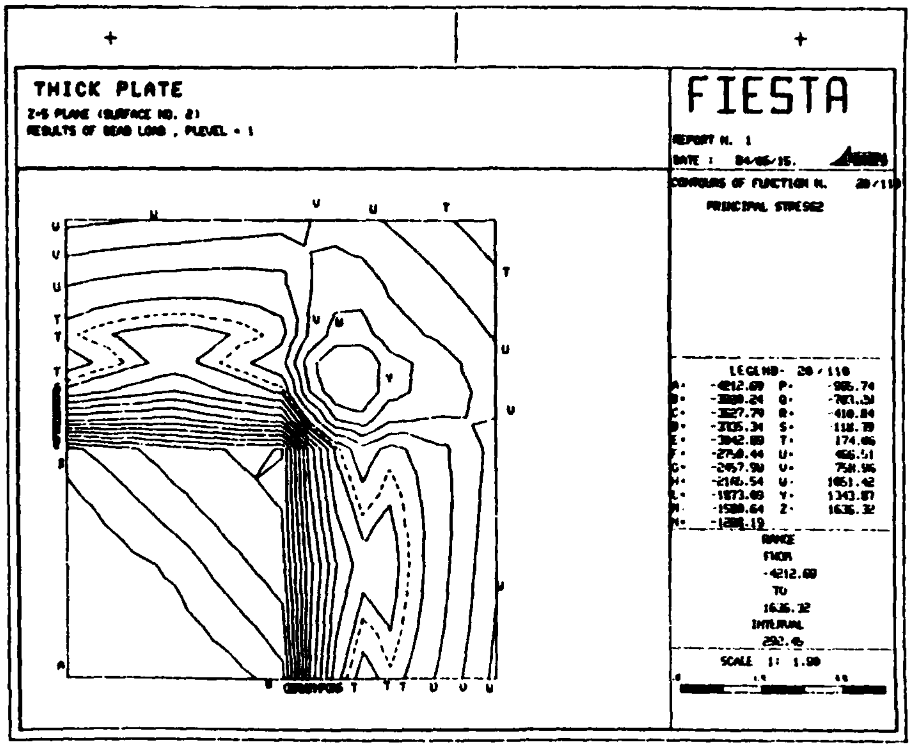


Figure D54. Y-direction principal stress contours for P-level 1 analysis with dead loading, thick plate

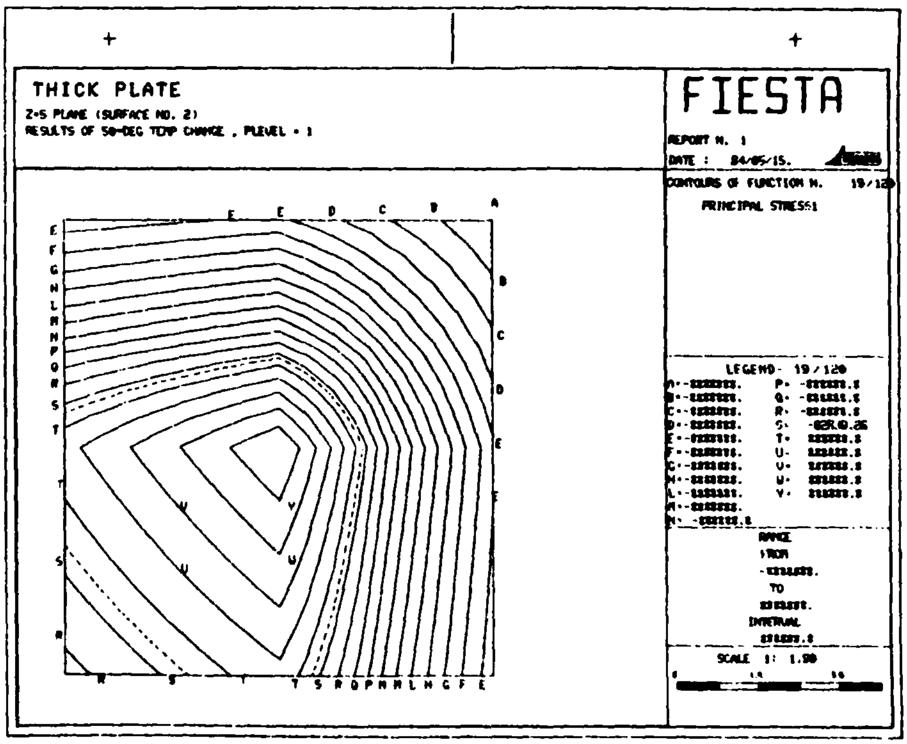


Figure D55. X-direction stress contours for P-level 1 analysis with temperature loading, thick plate

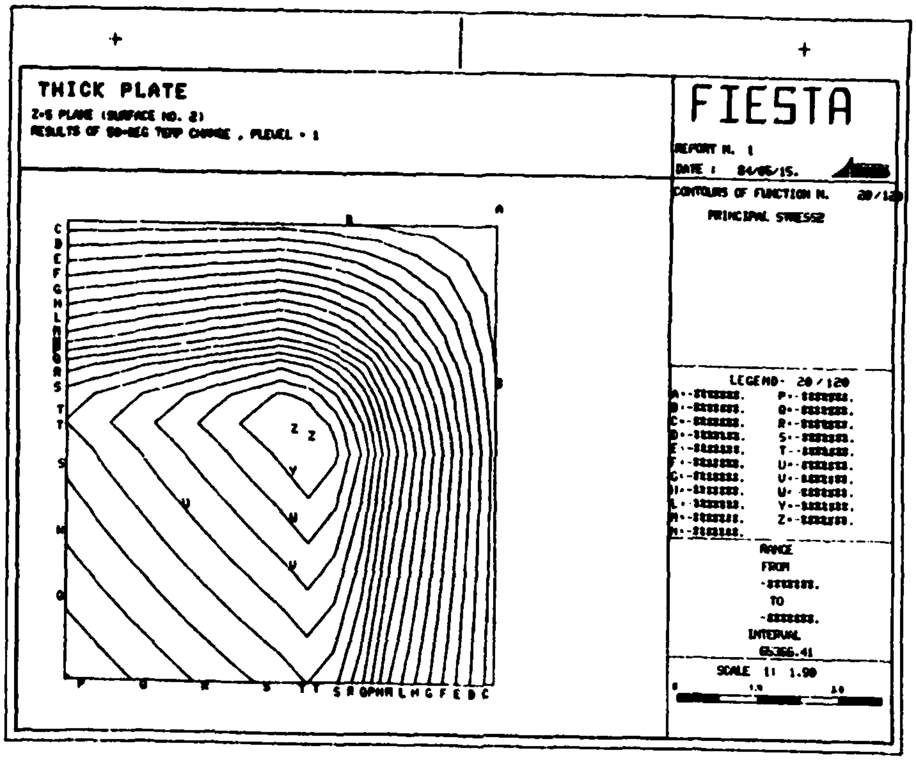


Figure D56. Y-direction principal stress contours for P-level 1 analysis with temperature loading, thick plate

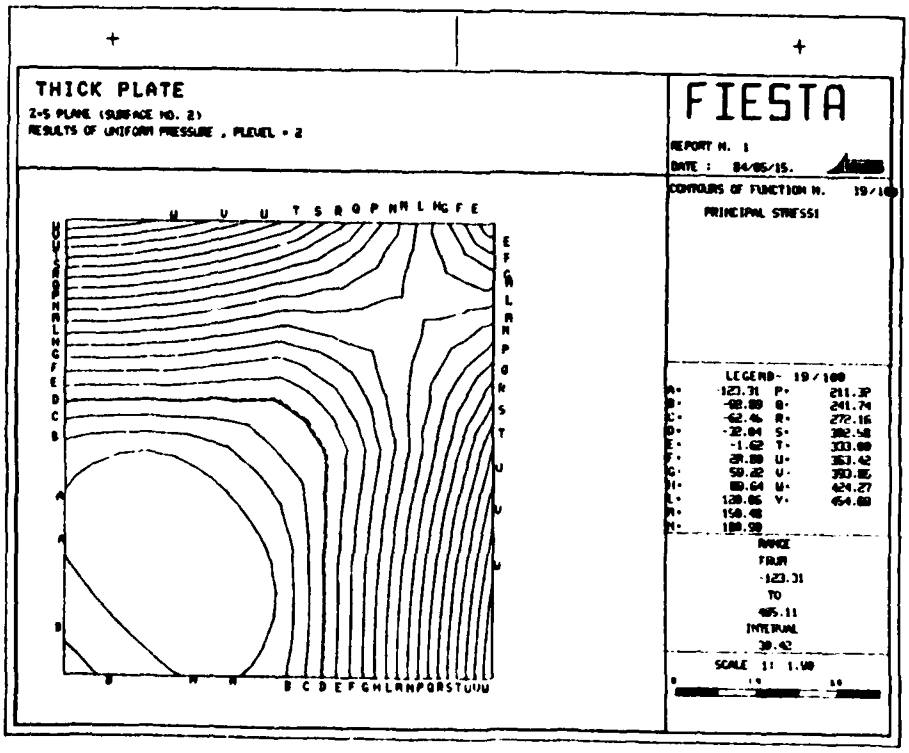


Figure D57. X-direction principal stress contours for P-level 2 analysis with uniform loading, thick plate

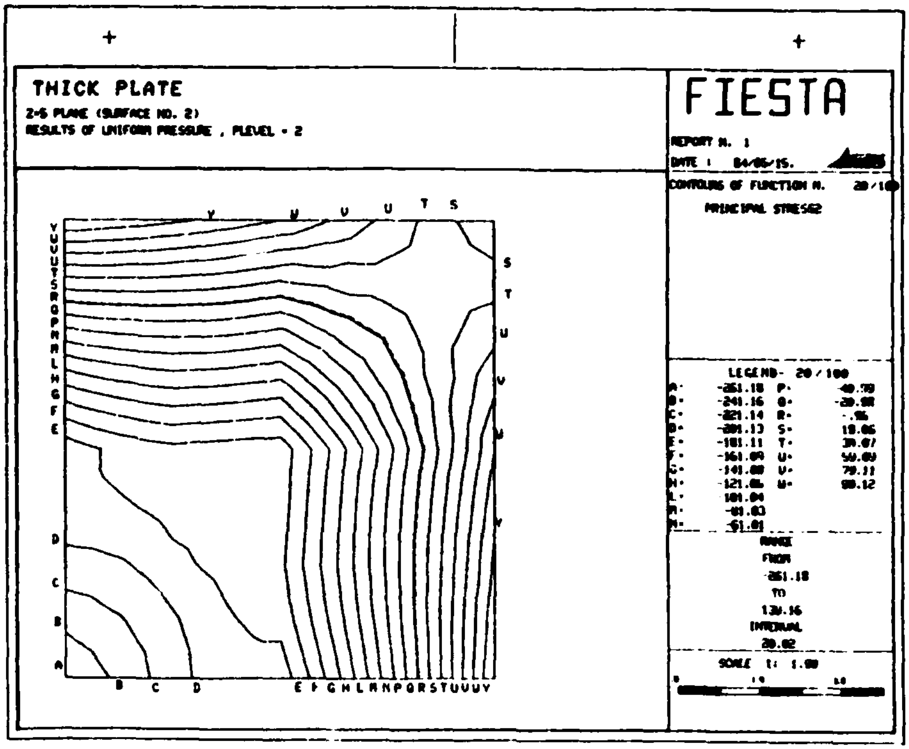


Figure D58. Y-direction principal stress contours for P-level 2 analysis with uniform pressure loading, thick plate

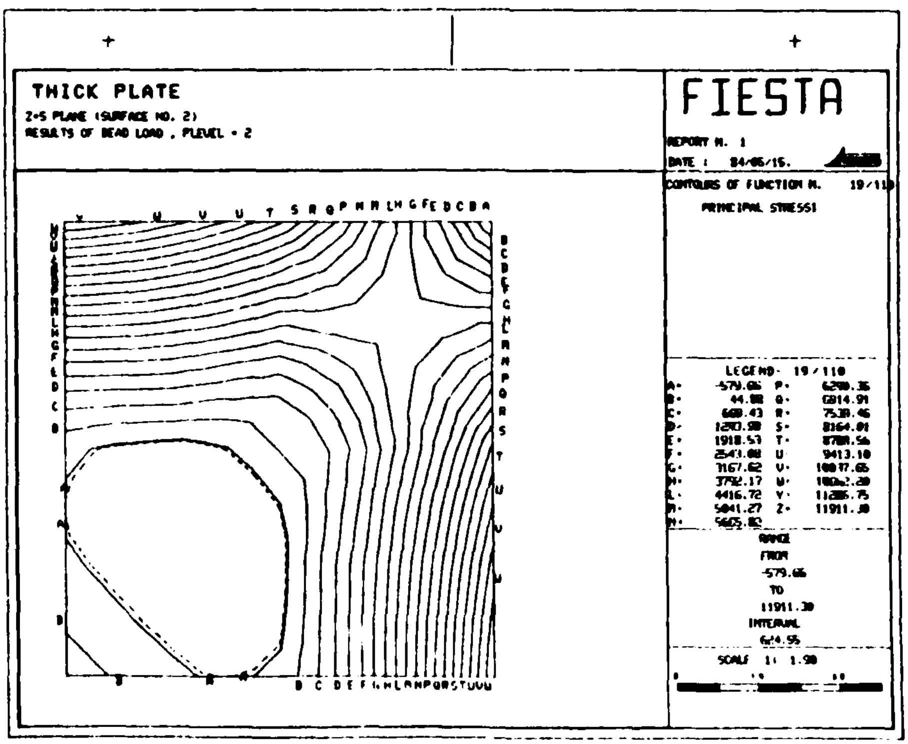


Figure D59. X-direction principal stress contours for P-level 2 analysis with dead loading, thick plate

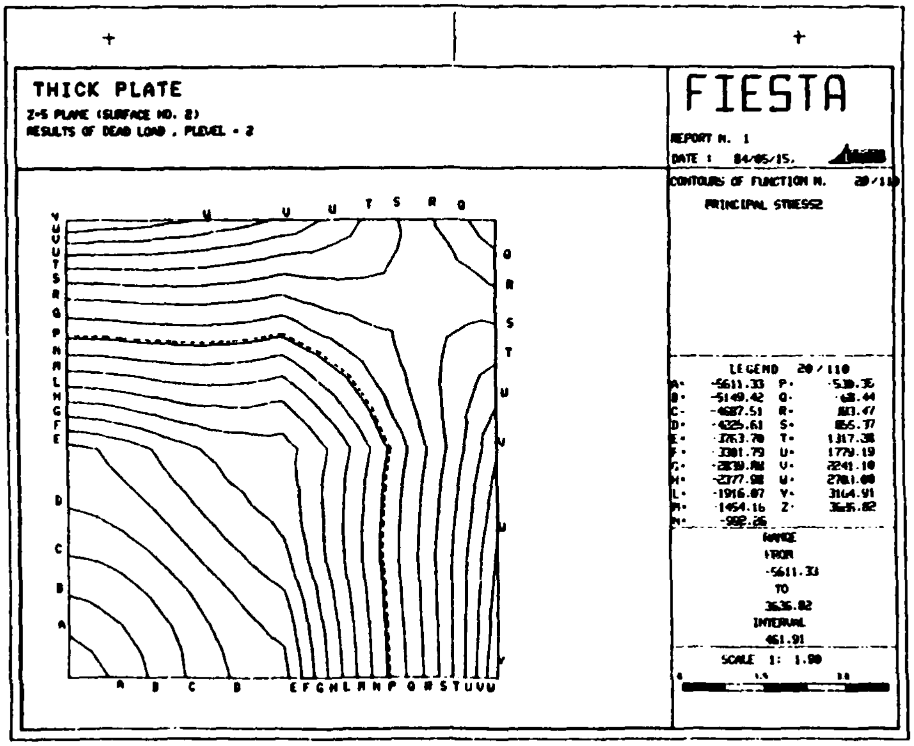


Figure D60. Y-direction principal stress contours for P-level 2 analysis with dead loading, thick plate

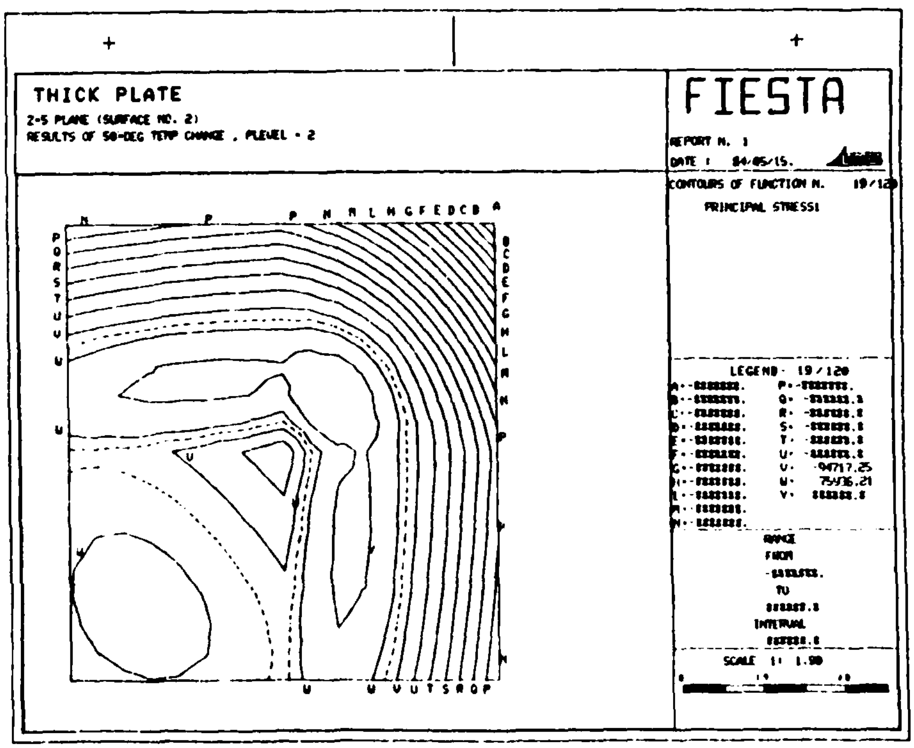


Figure D61. X-direction principal stress contours for P-level 2 analysis with temperature loading, thick plate

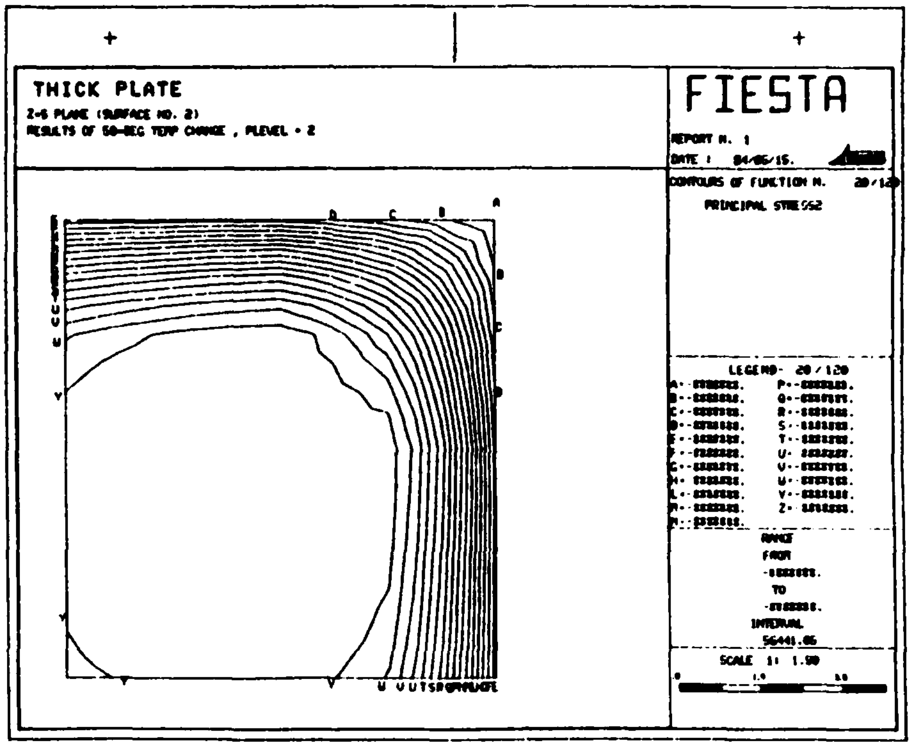


Figure D62. Y-direction principal stress contours for P-level 2 analysis with temperature loading, thick plate

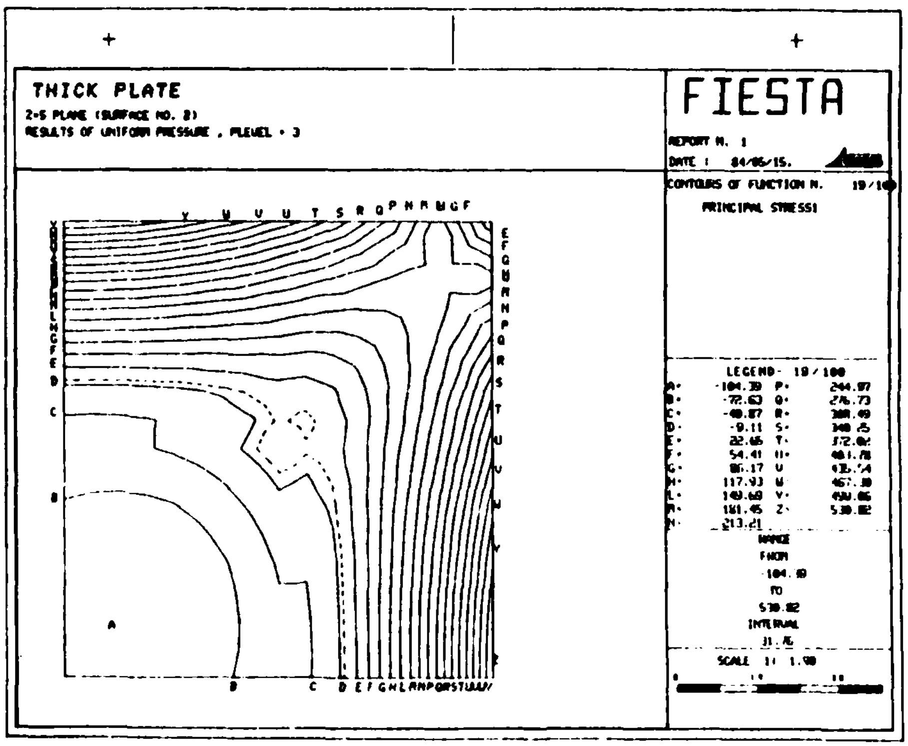


Figure D63. X-direction principal stress contours for P-level 3 analysis with uniform pressure loading, thick plate

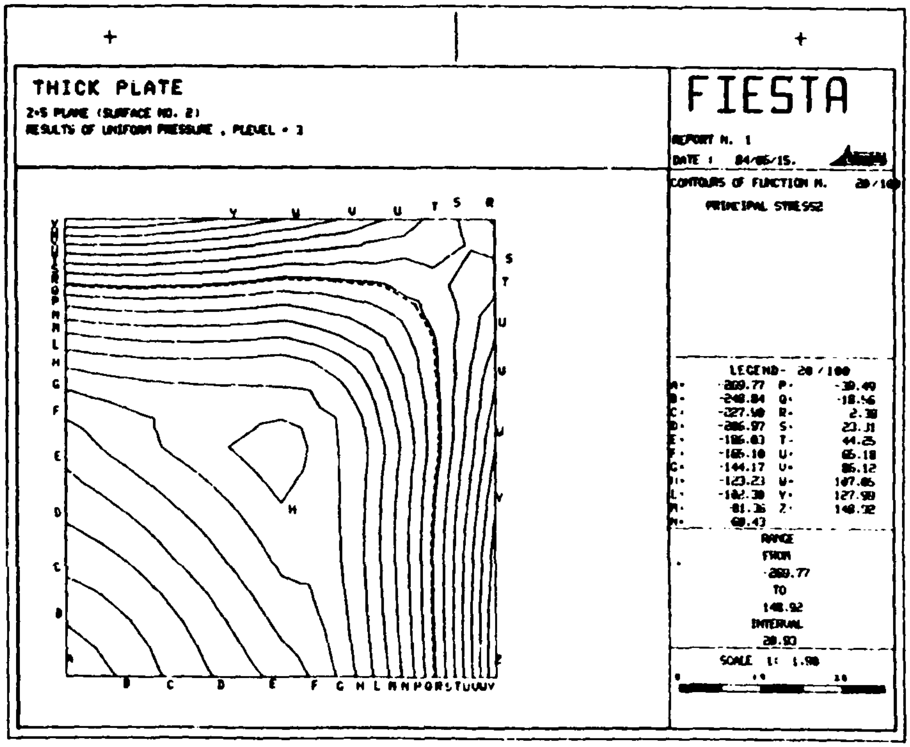


Figure D64. Y-direction principal stress contours for P-level 3 analysis with uniform pressure loading, thick plate

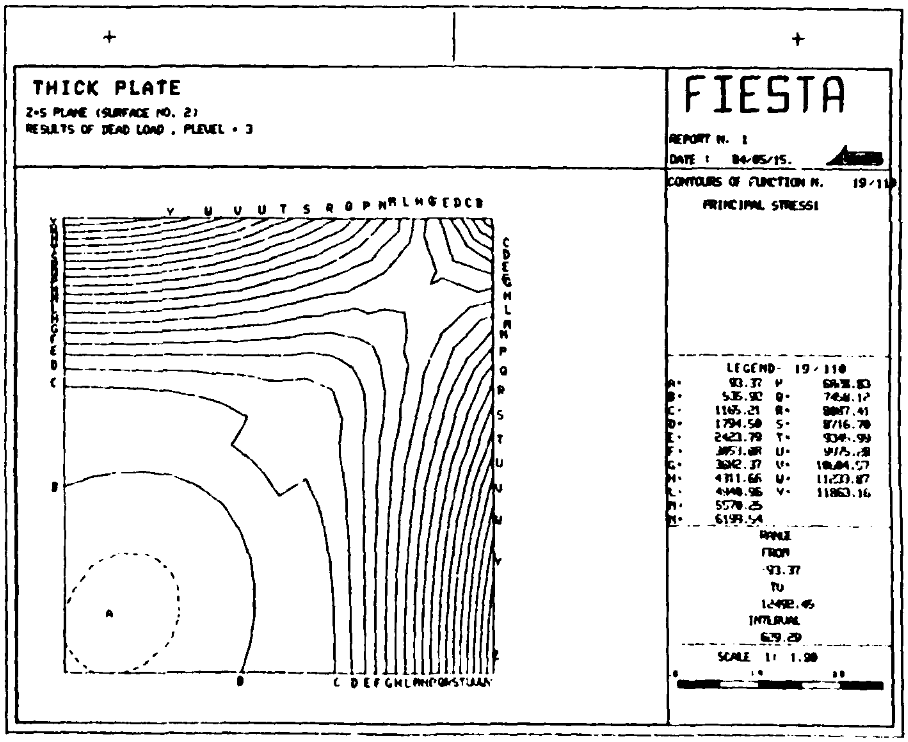


Figure D65. X-direction principal stress contours for P-level 3 analysis with dead loading, thick plate

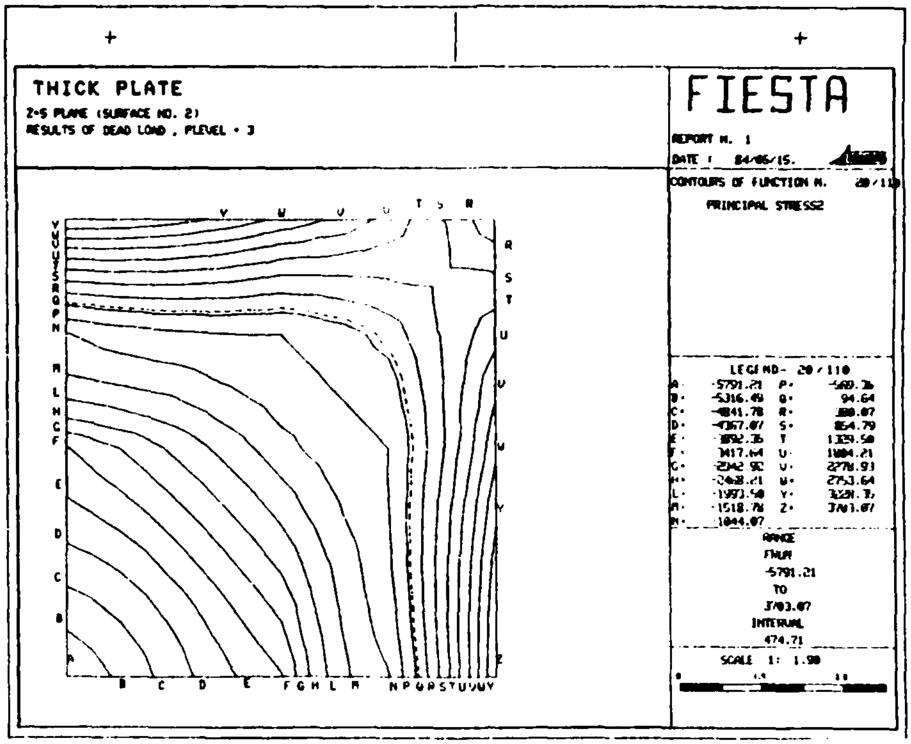


Figure D66. Y-direction principal stress contours for P-level 3 analysis with dead loading, thick plate

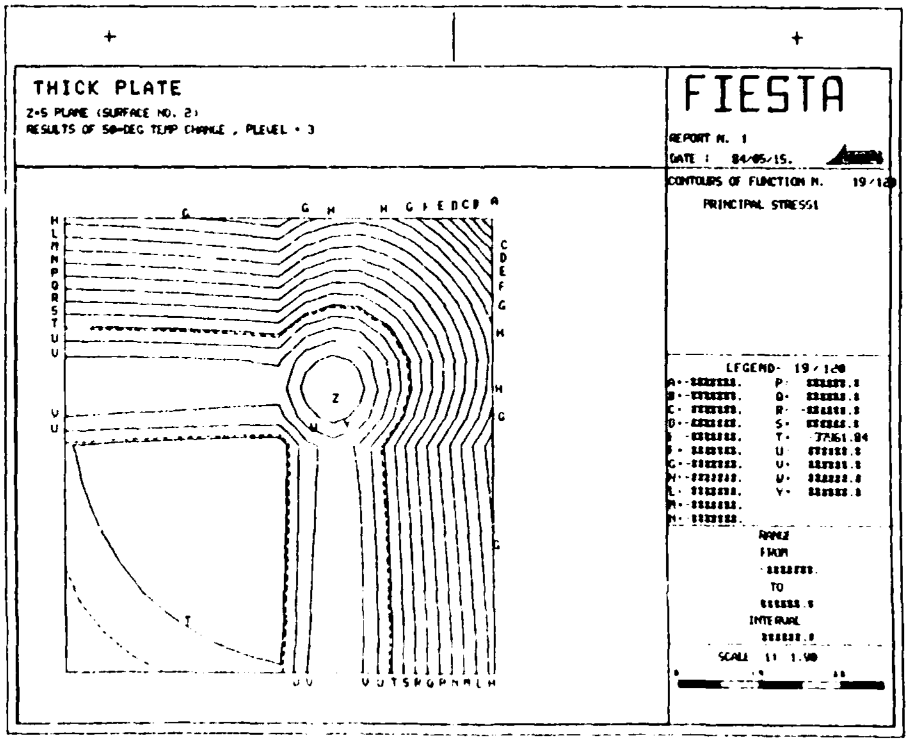


Figure D67. X-direction principal stress contours for P-level 3 analysis with temperature loading, thick plate

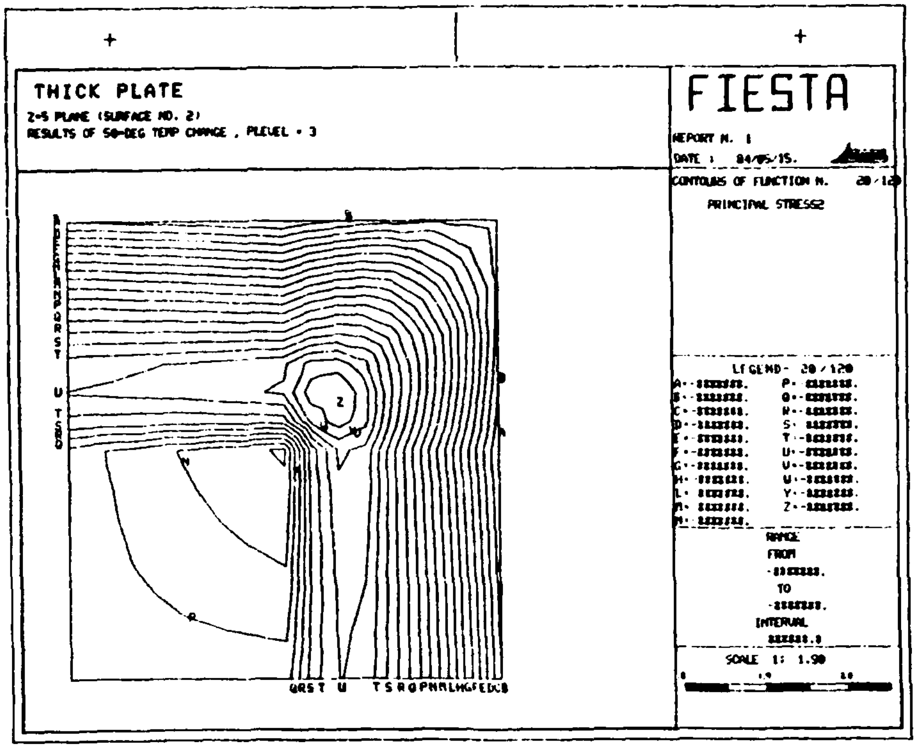


Figure D68. Y-direction principal stress contours for P-level 3 analysis with temperature loading, thick plate

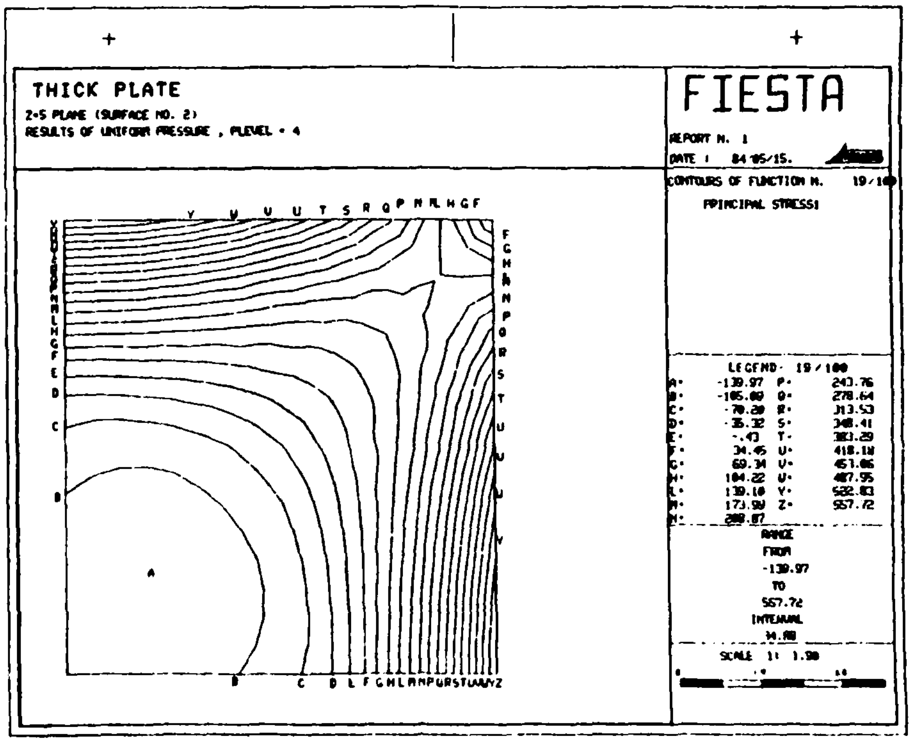


Figure D69. X-direction principal stress contours for P-level 4 analysis with uniform pressure loading, thick plate

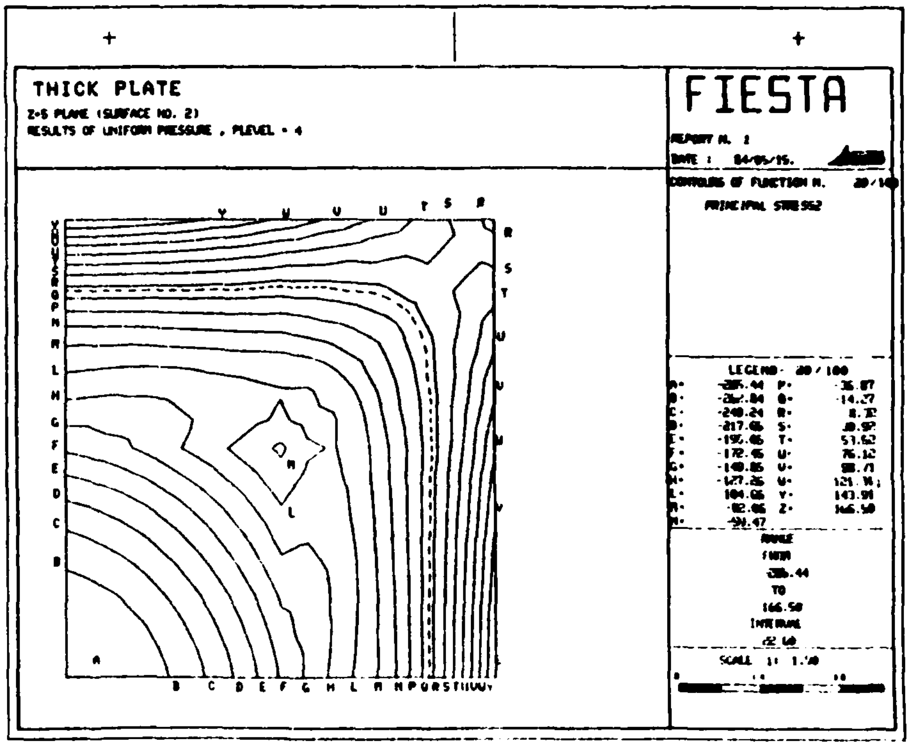


Figure D70. Y-direction principal stress contours for P-level 4 analysis with uniform pressure loading, thick plate

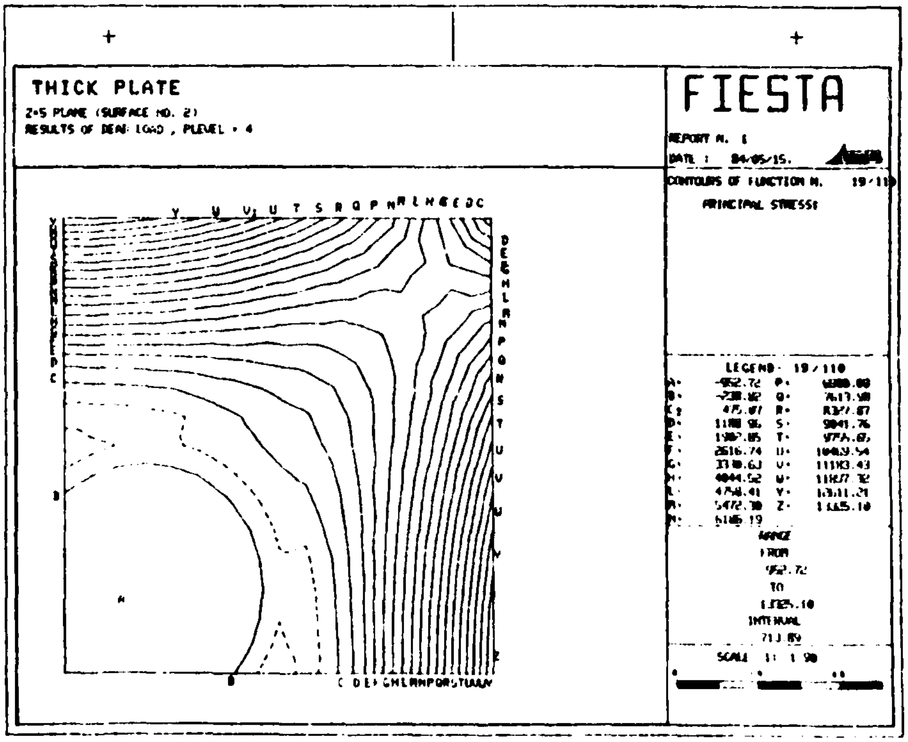


Figure D71. X-direction principal stress contours for P-level 4 analysis with dead loading, thick plate

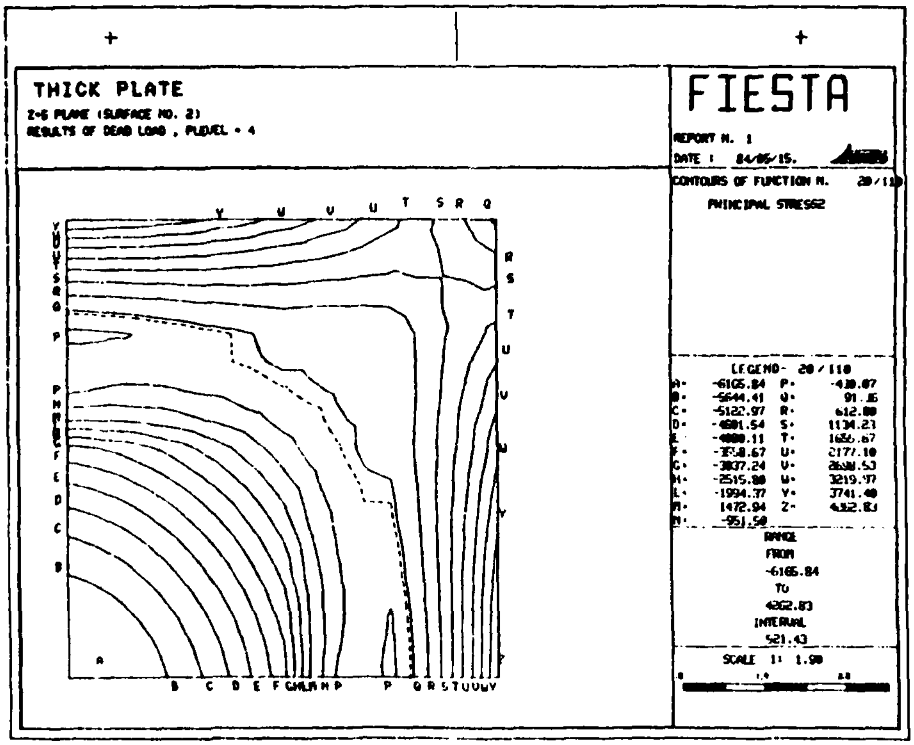


Figure D72. Y-direction principal stress contours for P-level 4 analysis with dead loading, thick plate

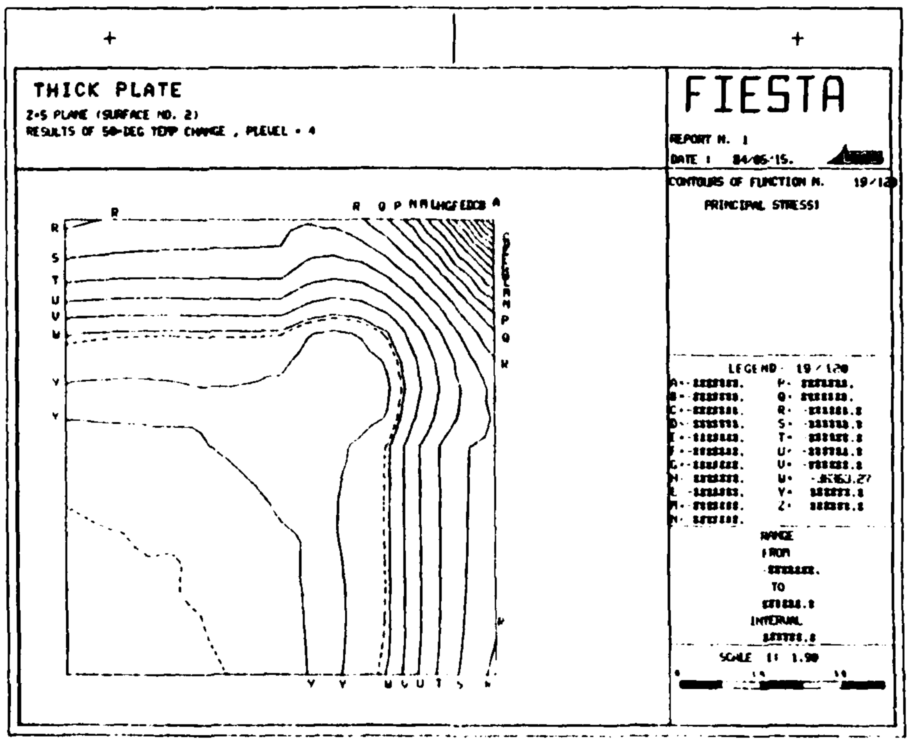


Figure D73. X-direction principal stress contours for P-level 4 analysis with temperature loading, thick plate

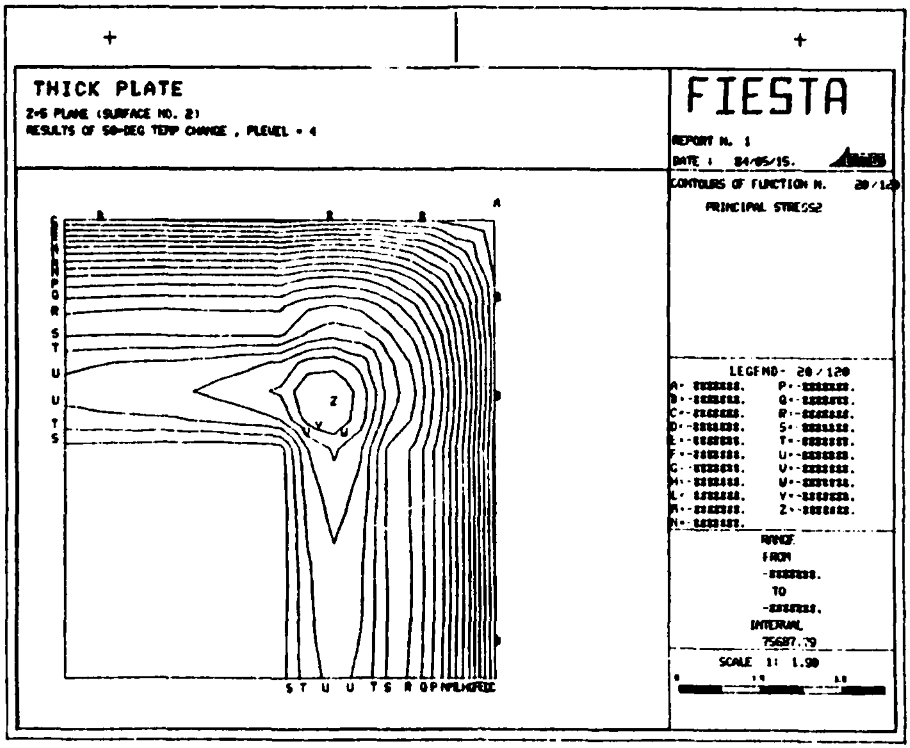


Figure D74. Y-direction principal stress contours for P-level 4 analysis with temperature loading, thick plate

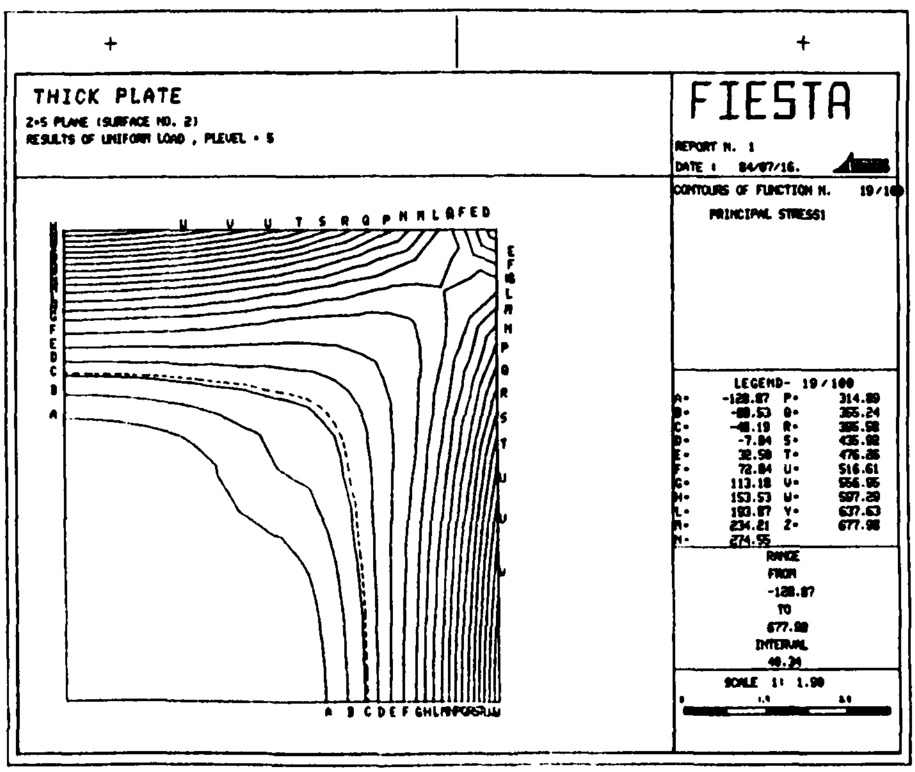


Figure D75. X-direction principal stress contours for P-level 5 analysis with uniform pressure loading, thick plate

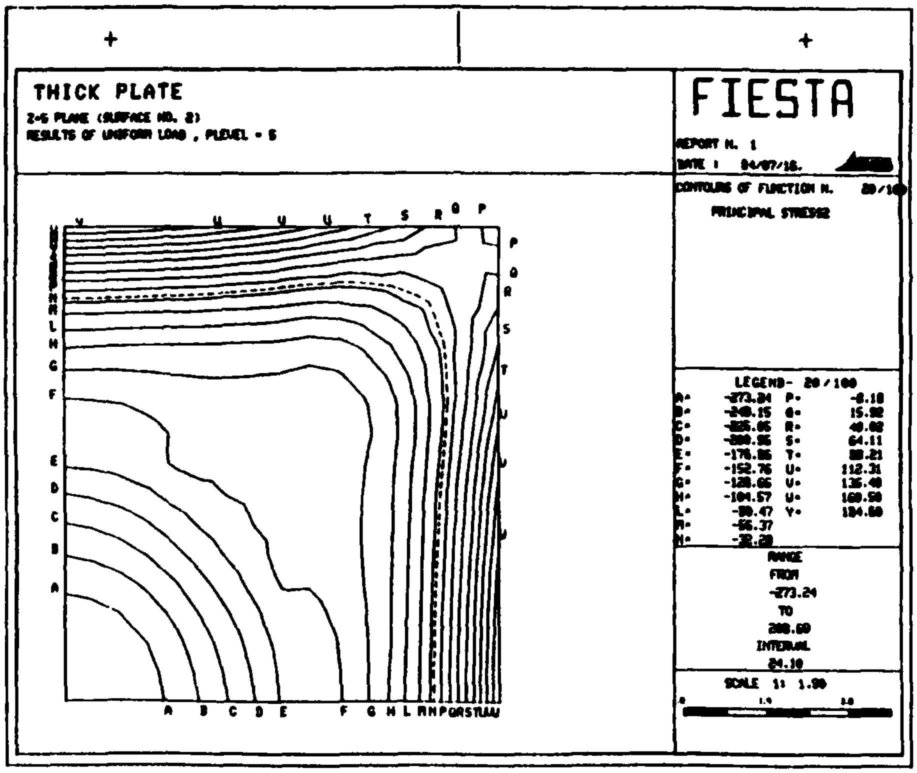


Figure D76. Y-direction principal stress contours for P-level 5 analysis with uniform pressure loading, thick plate

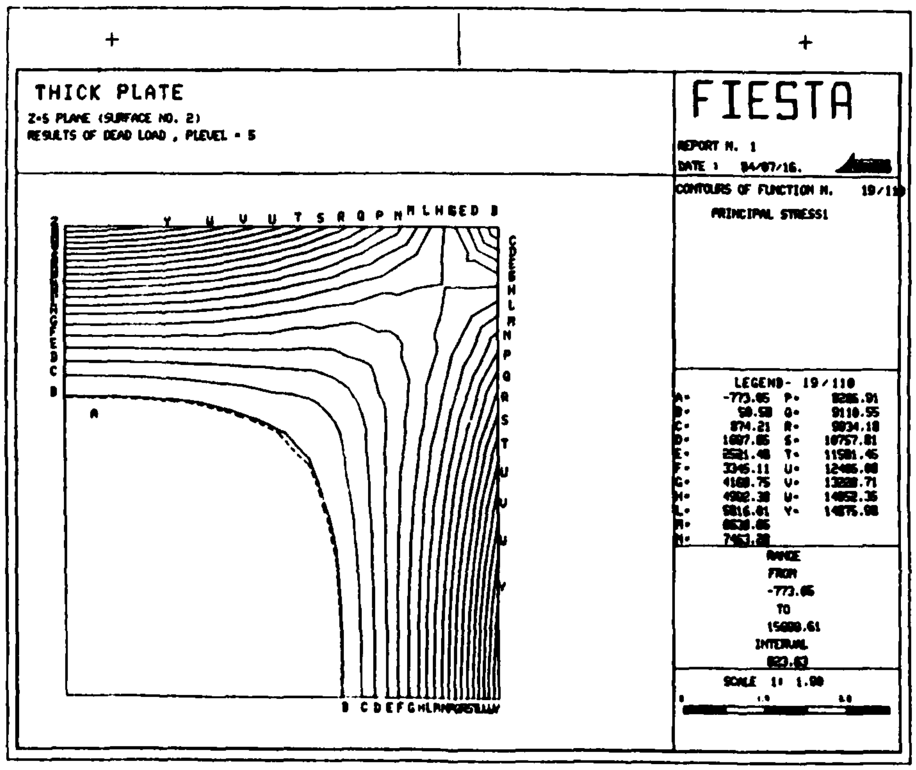


Figure D77. X-direction principal stress contours for P-level 5 analysis with dead loading, thick plate

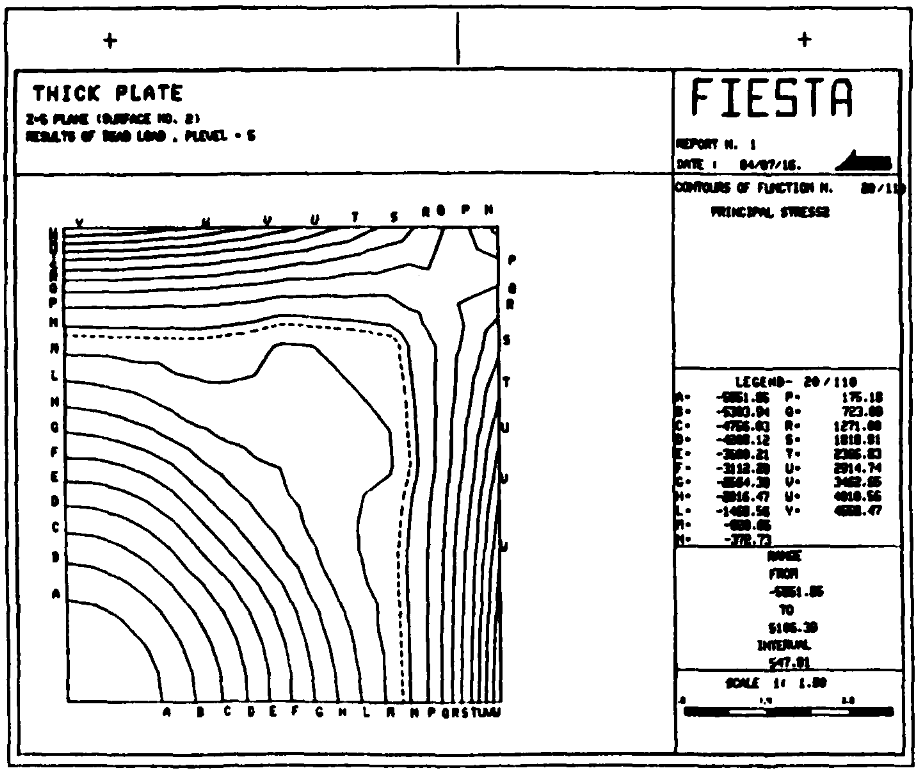


Figure D78. Y-direction principal stress contours for P-level 5 analysis with dead loading, thick plate

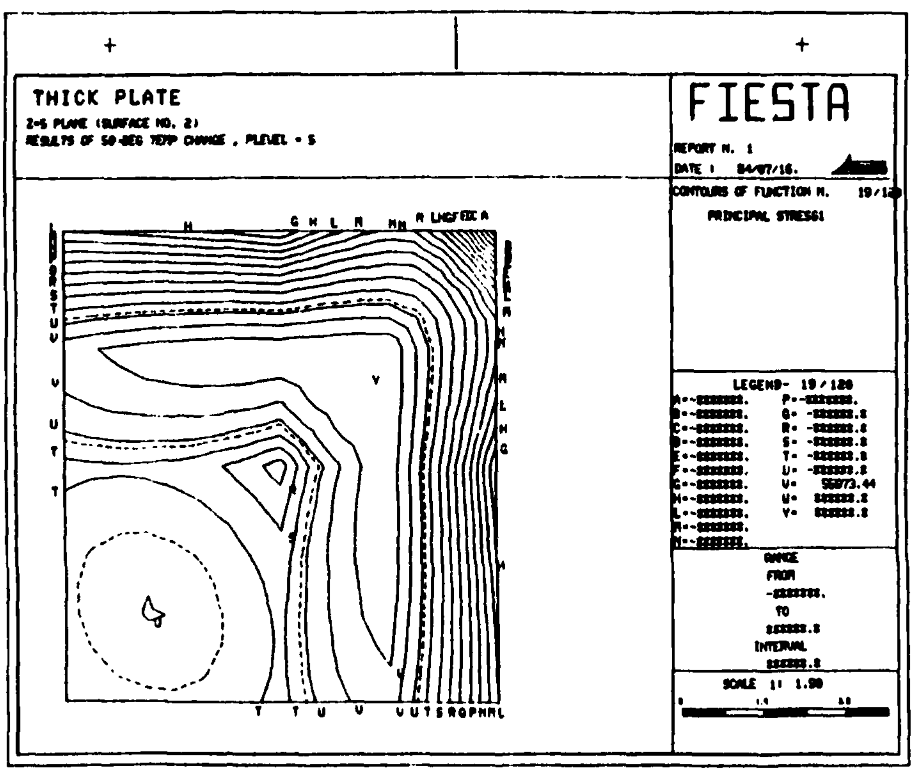


Figure D79. X-direction principal stress contours for P-level 5 analysis with temperature loading, thick plate

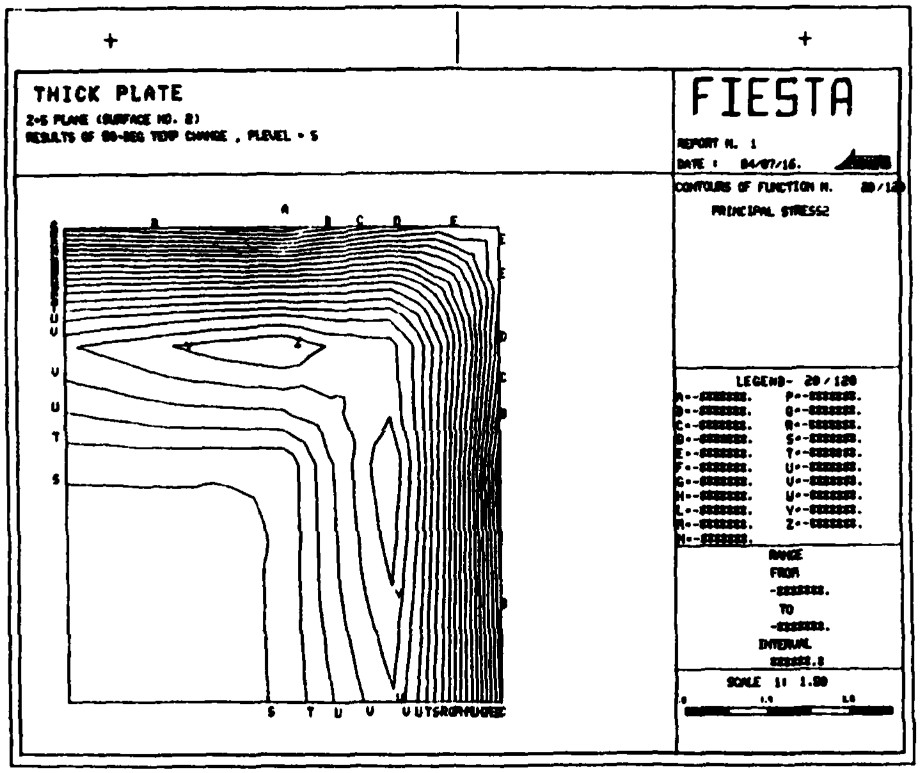


Figure D80. Y-direction principal stress contours for P-level 5 analysis with temperature loading, thick plate

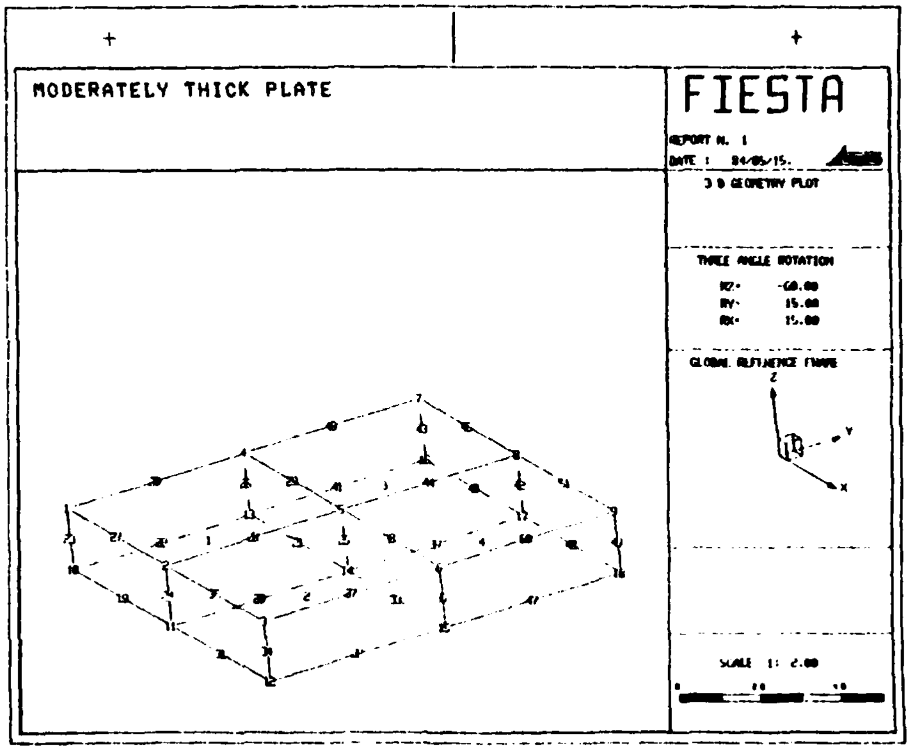


Figure D81. FIESTA moderately thick plate geometry with node and element numbering

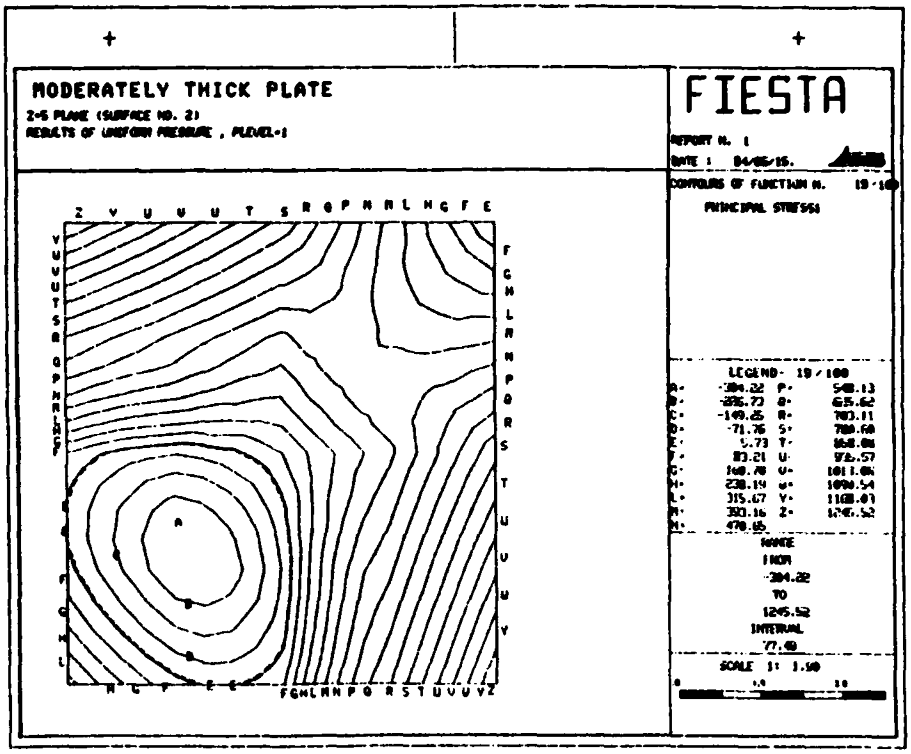


Figure D82. X-direction principal stress contours for P-level 1 analysis with uniform pressure loading, moderately thick plate

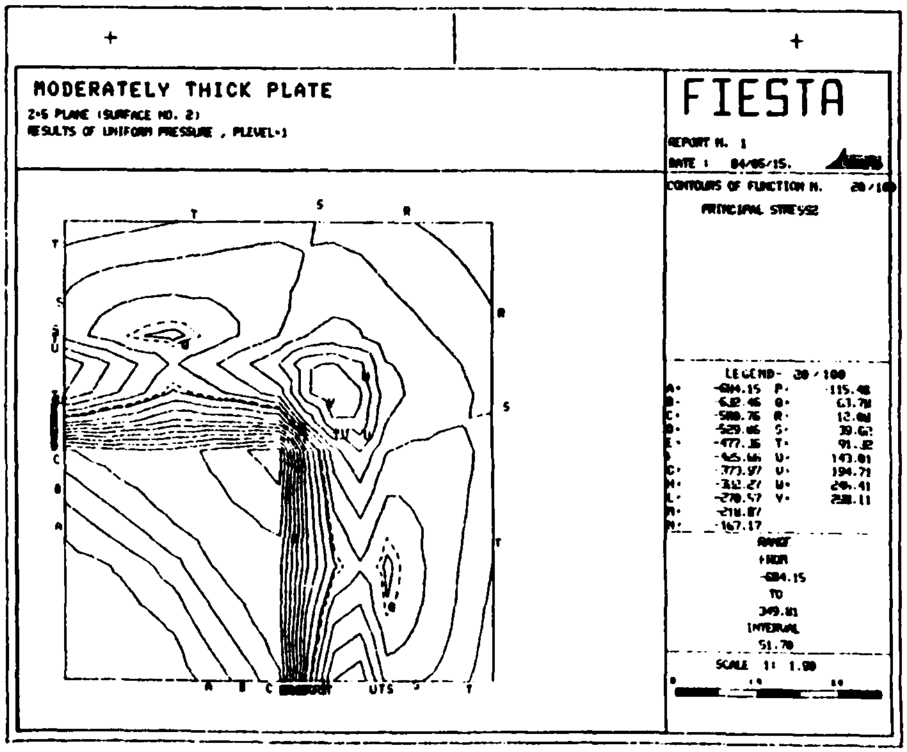


Figure D83. Y-direction principal stress contours for P-level 1 analysis with uniform pressure loading, moderately thick plate

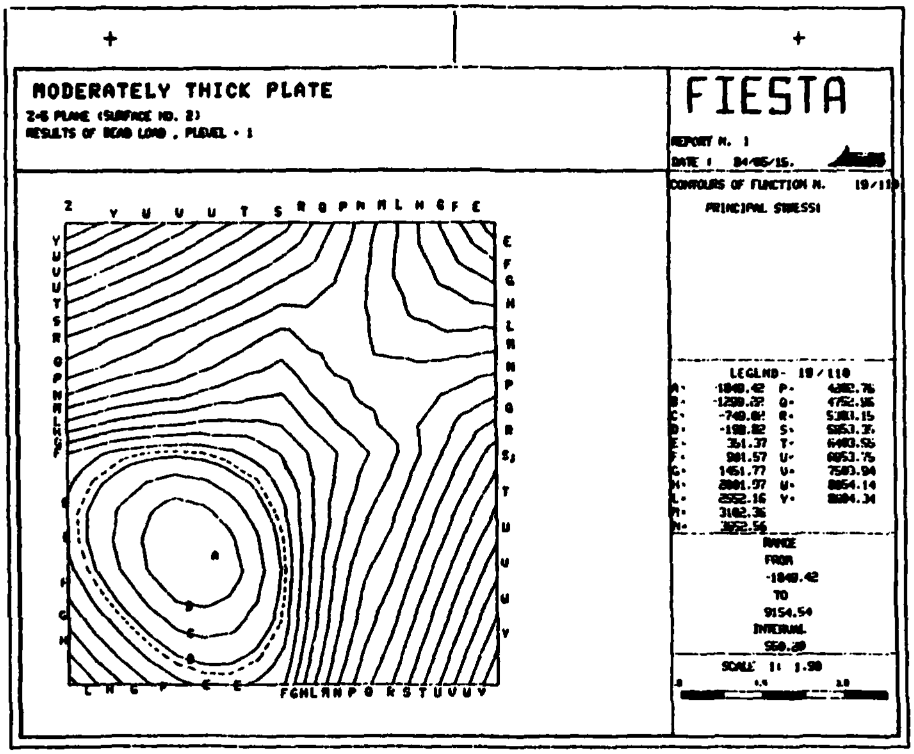


Figure D84. X-direction principal stress contours for P-level 1 analysis with dead loading, moderately thick plate

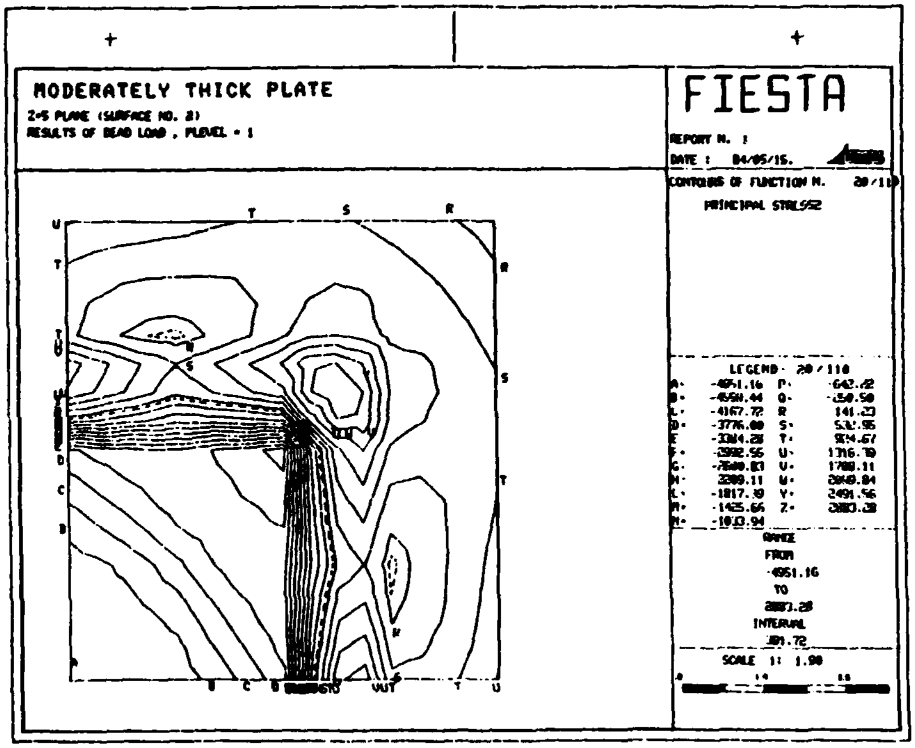


Figure D85. Y-direction principal stress contours for P-level 1 analysis with dead loading, moderately thick plate

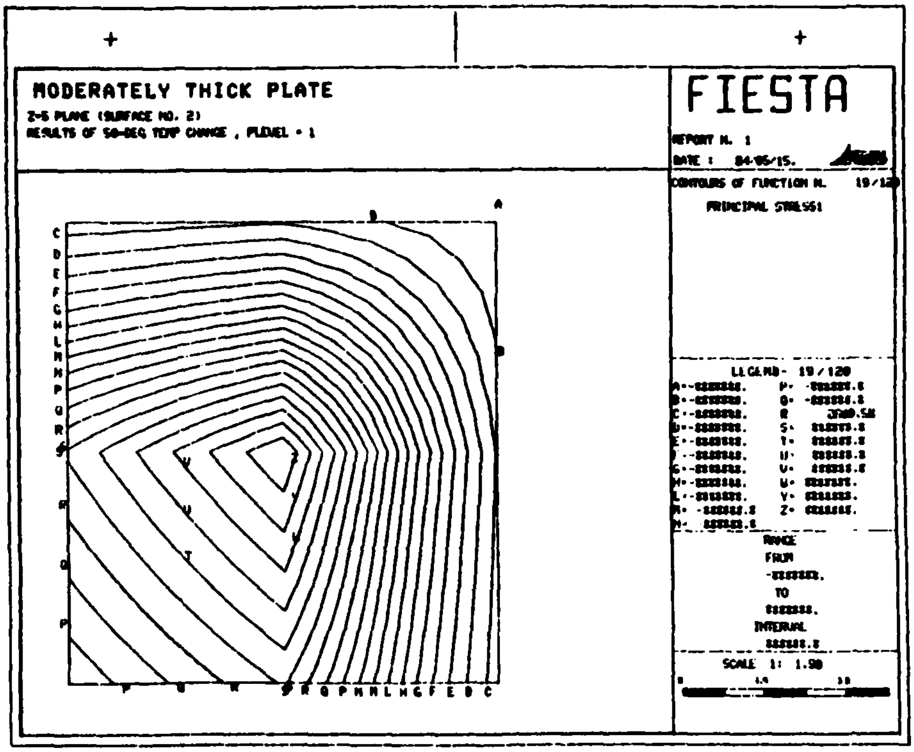


Figure D86. X-direction principal stress contours for P-level 1 analysis with temperature loading, moderately thick plate

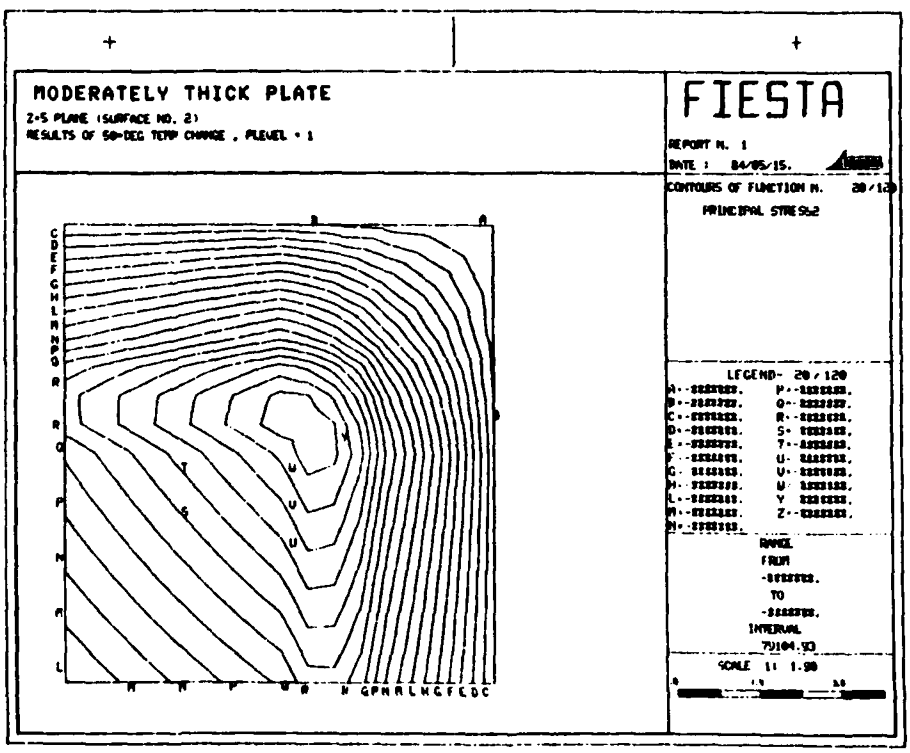


Figure D87. Y-direction principal stress contours for P-level 1 analysis with temperature loading, moderately thick plate

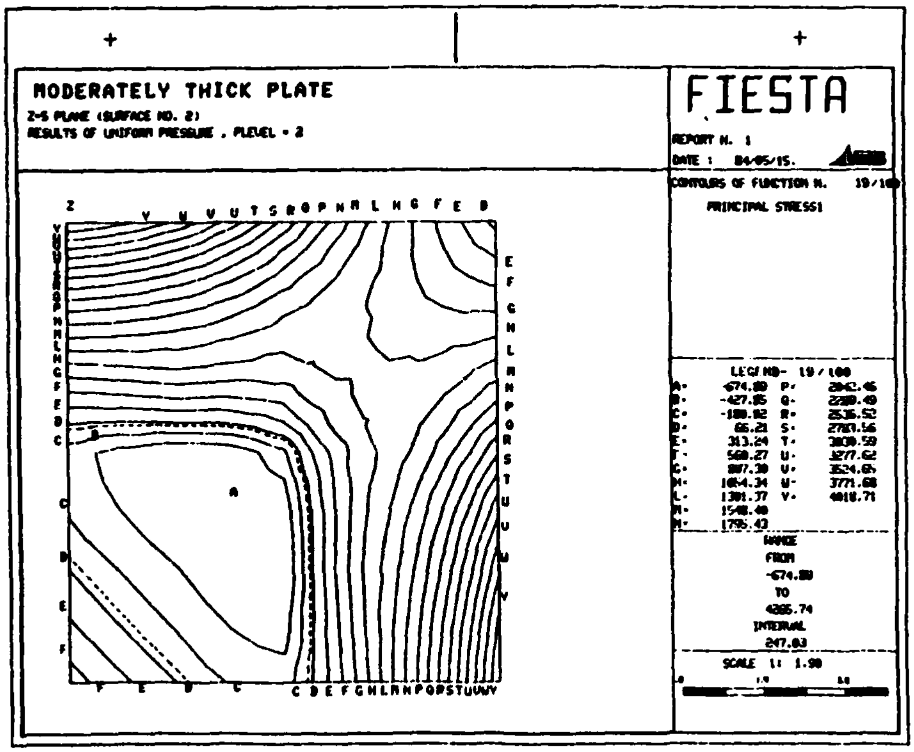


Figure D88. X-direction principal stress contours for P-level 2 analysis with uniform pressure loading, moderately thick plate

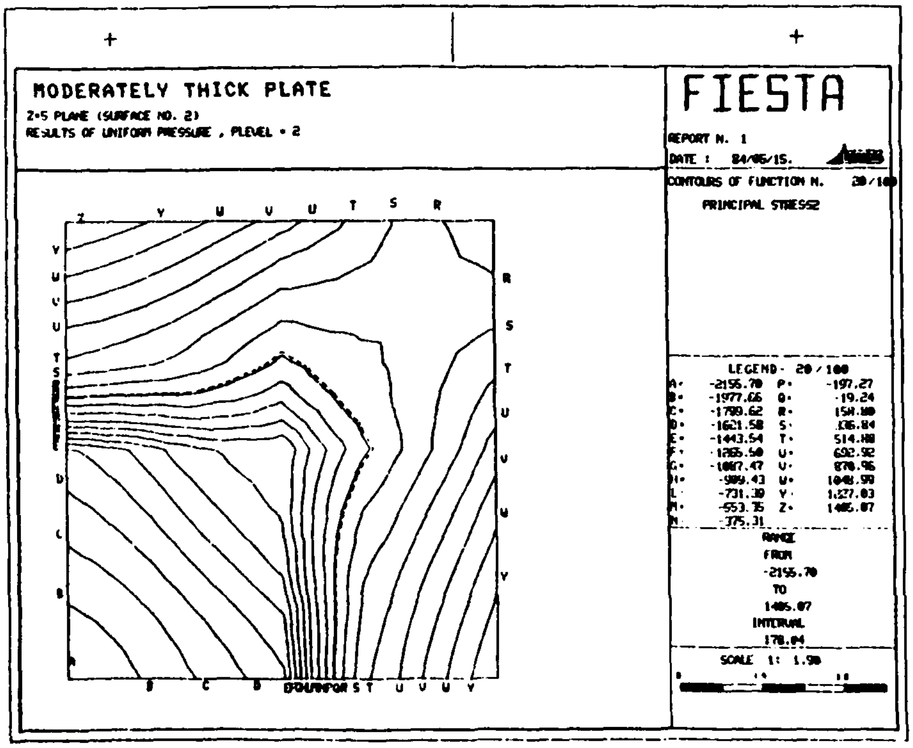


Figure D89. Y-direction principal stress contours for P-level 2 analysis with uniform pressure loading, moderately thick plate

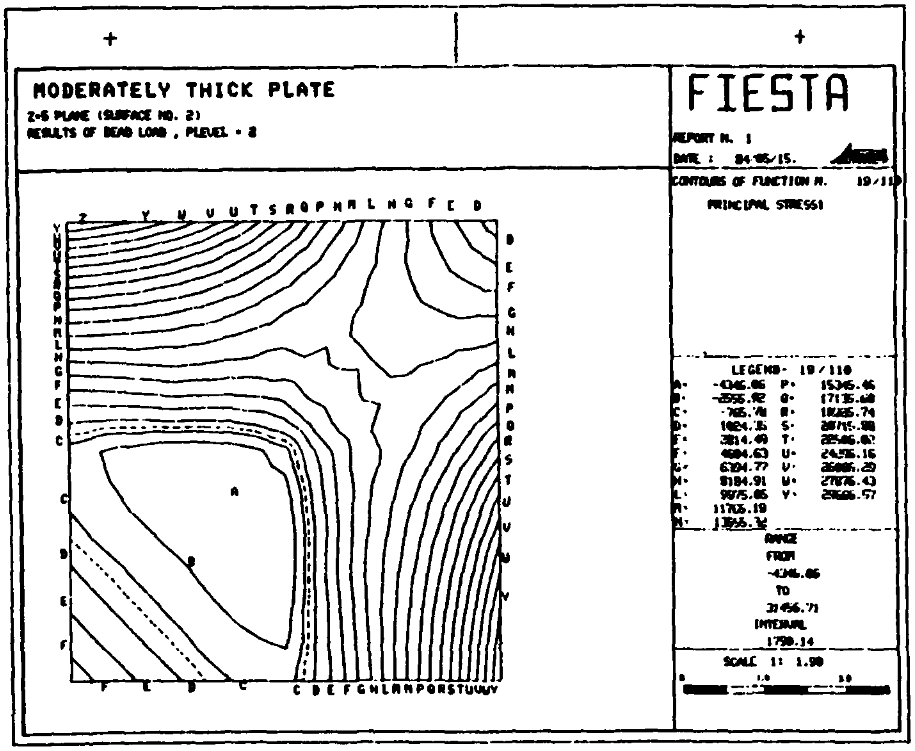


Figure D90. X-direction principal stress contours for P-level 2 analysis with dead loading, moderately thick plate

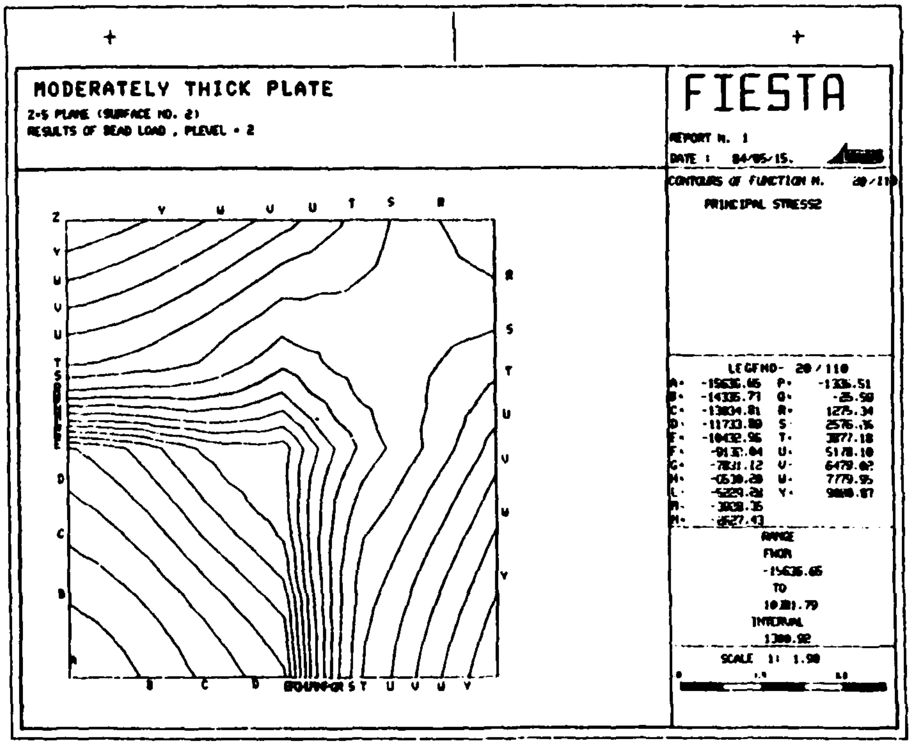


Figure D91. Y-direction principal stress contours for P-level 2 analysis with dead loading, moderately thick plate

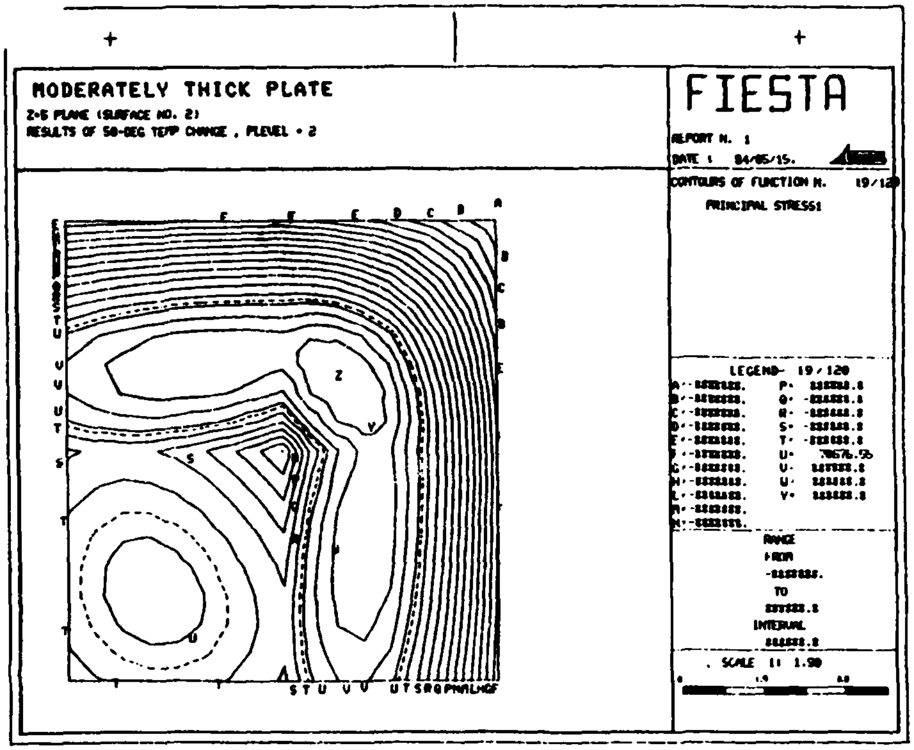


Figure D92. X-direction principal stress contours for P-level 2 analysis with temperature loading, moderately thick plate

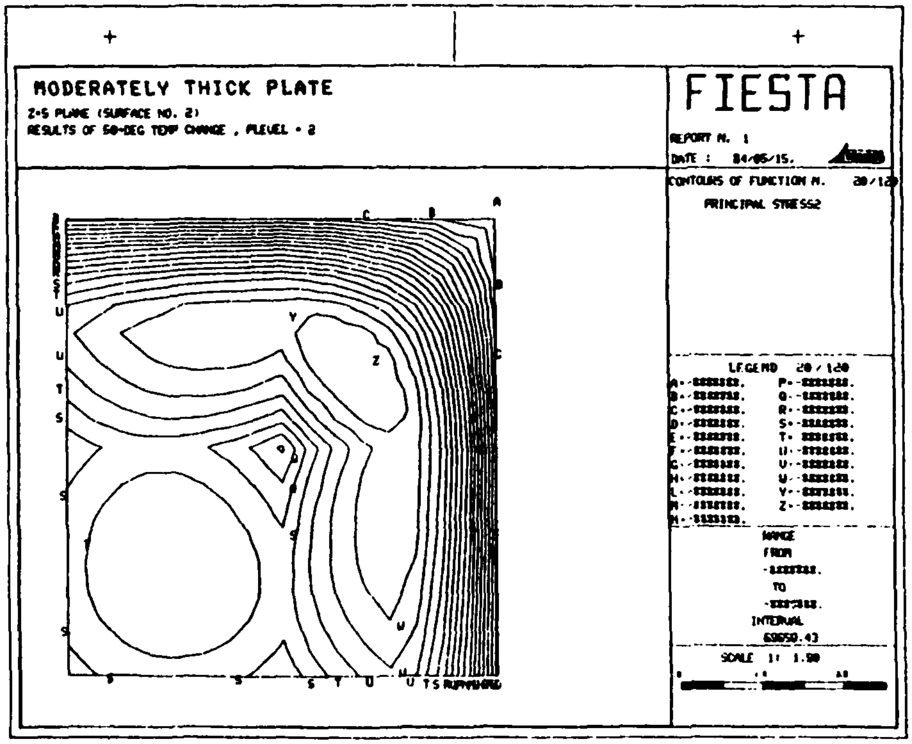


Figure D93. Y-direction principal stress contours for P-level 2 analysis with temperture loading, moderately thick plate

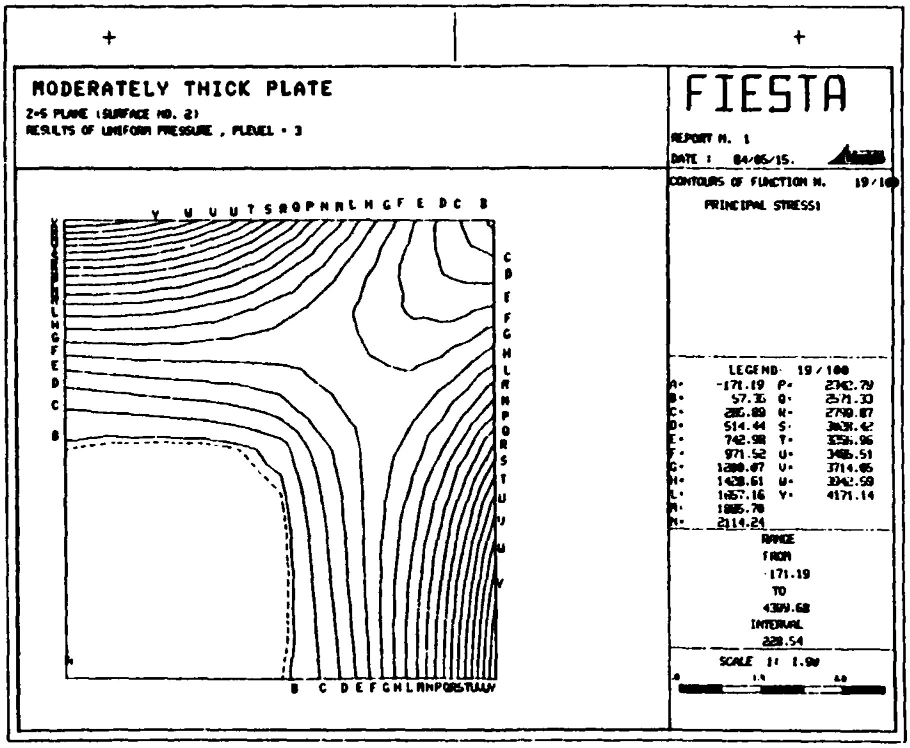


Figure D94. X-direction principal stress contours for P-level 3 analysis with uniform pressure loading, moderately thick plate

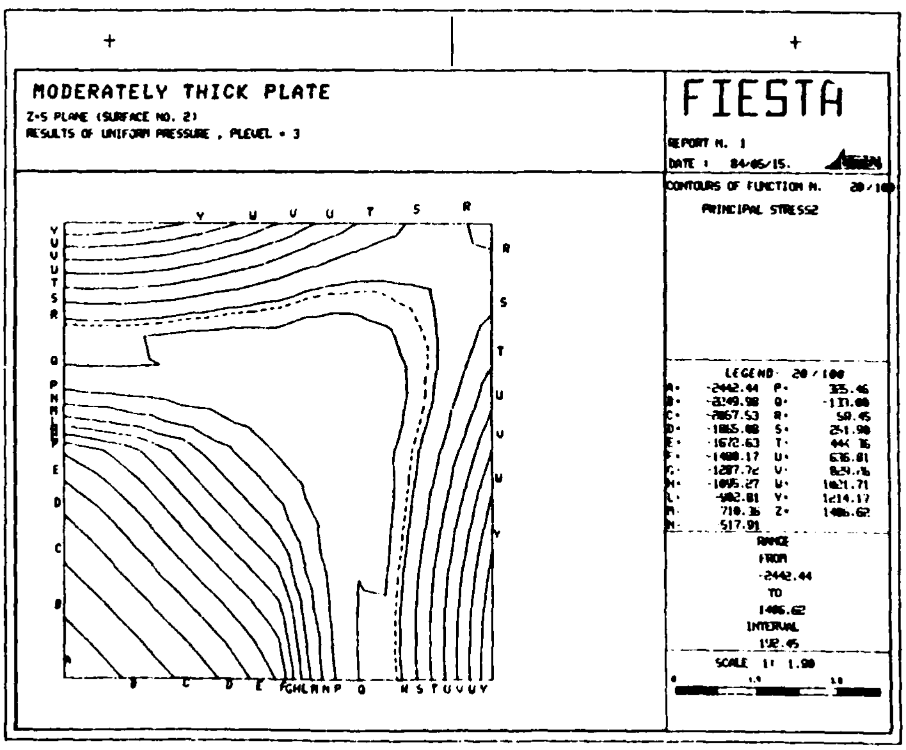


Figure D95. Y-direction principal stress contours for P-level 3 analysis with uniform pressure loading, moderately thick plate

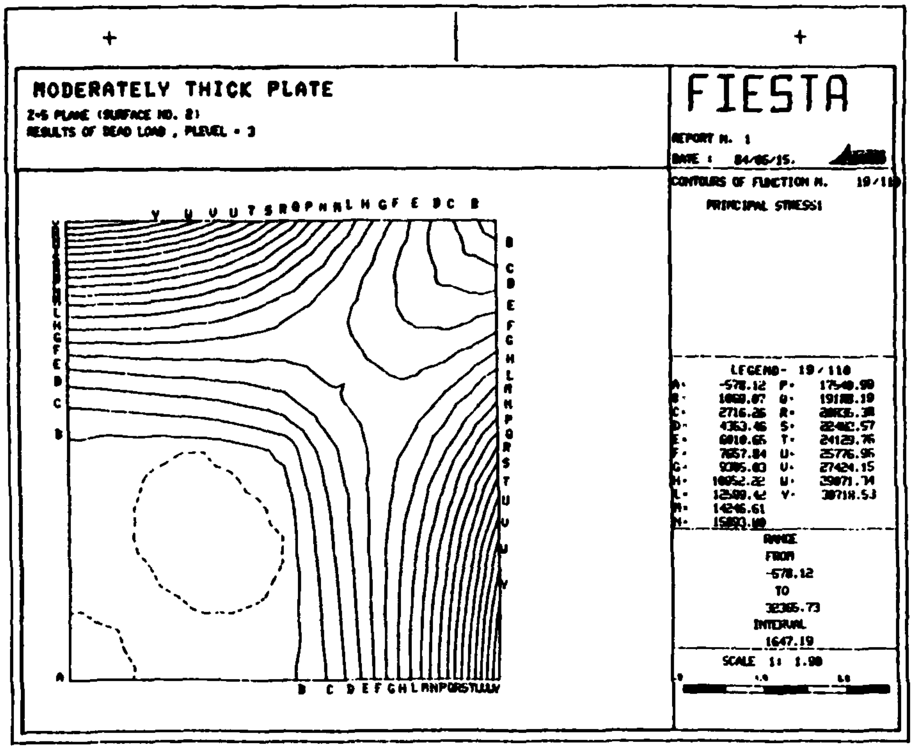


Figure D96. X-direction principal stress contours for P-level 3 analysis with dead loading, moderately thick plate

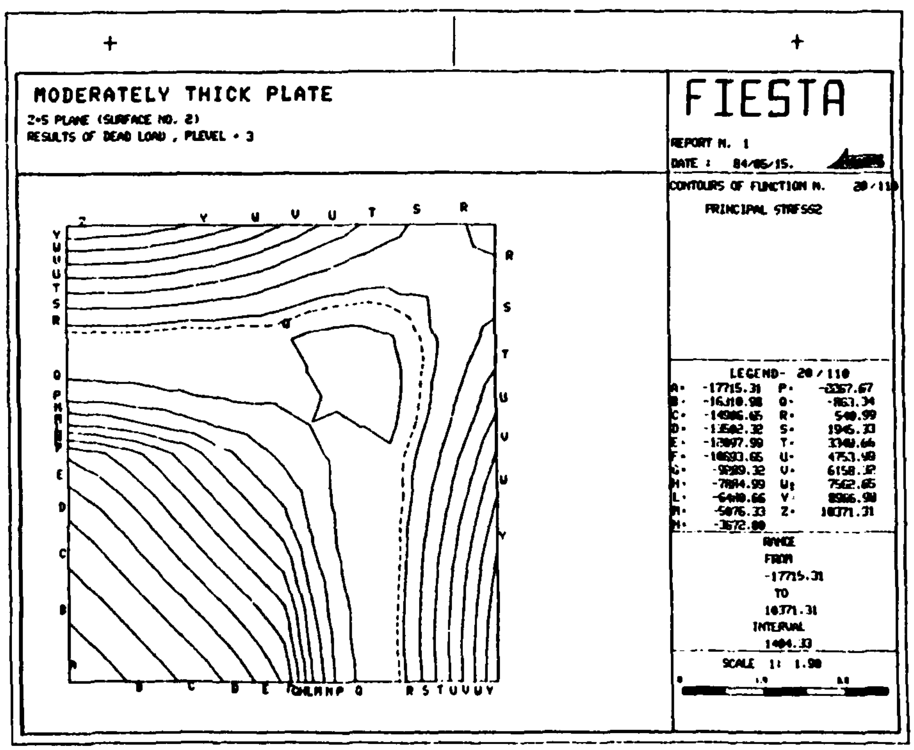


Figure D97. Y-direction principal stress contours for P-level 3 analysis with dead loading, moderately thick plate

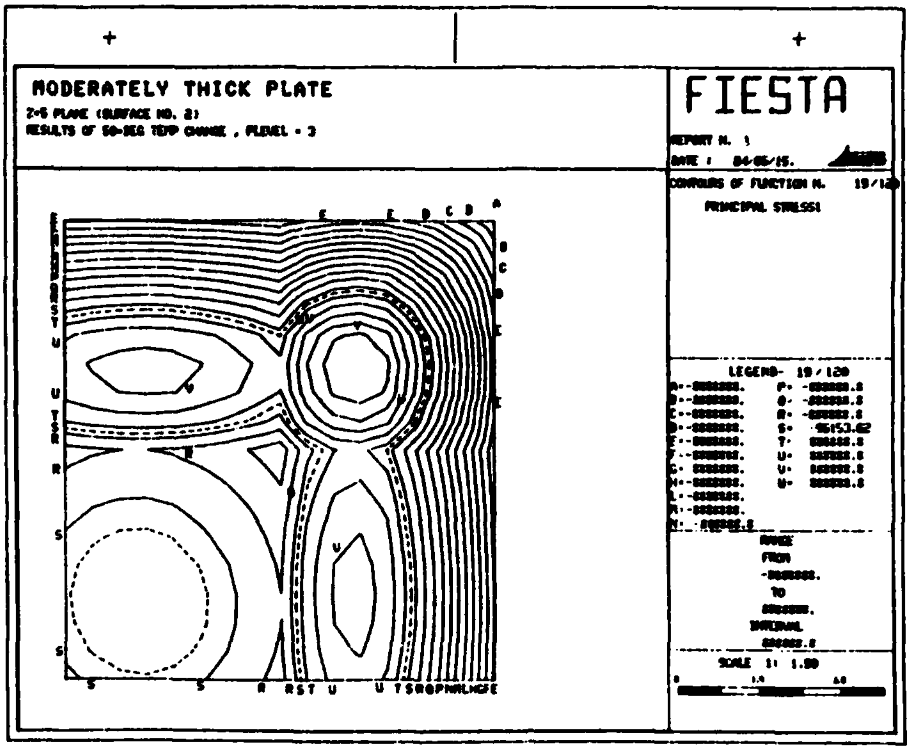


Figure D98. X-direction principal stress contours for P-level 3 analysis with temperature loading, moderately thick plate

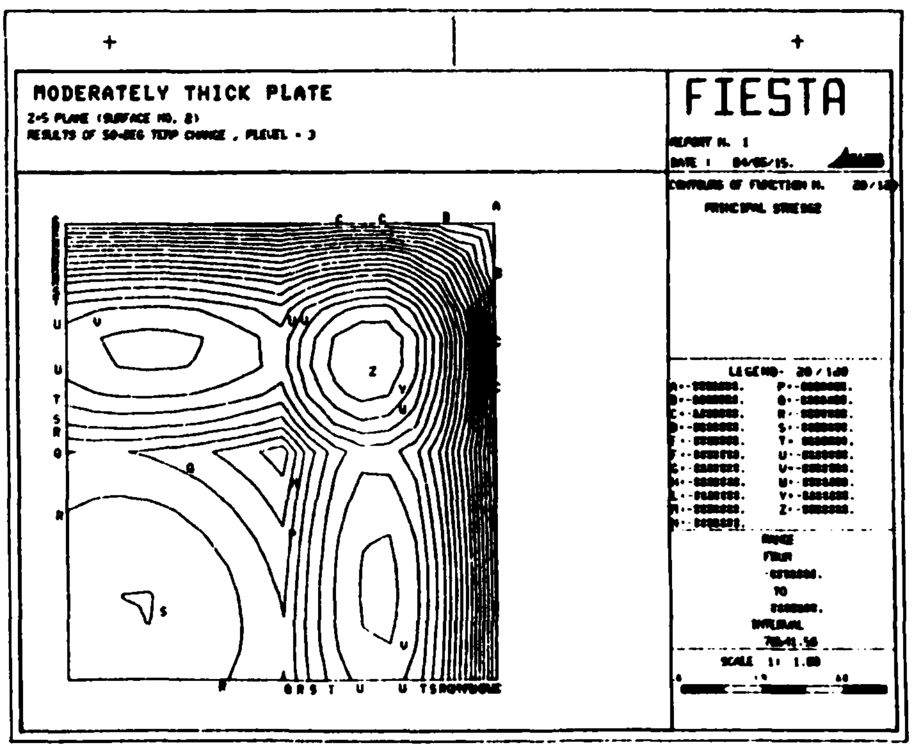


Figure D99. Y-direction principal stress contours for P-level 3 analysis with temperature loading, moderately thick plate

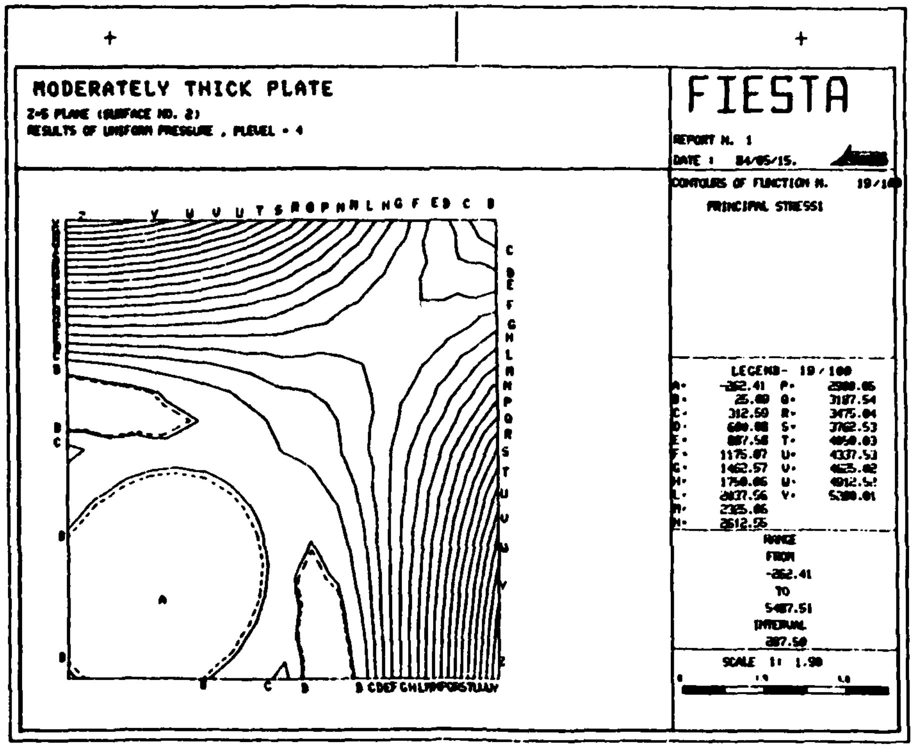


Figure D100. X-direction principal stress contours for P-level 4 analysis with uniform pressure loading, moderately thick plate

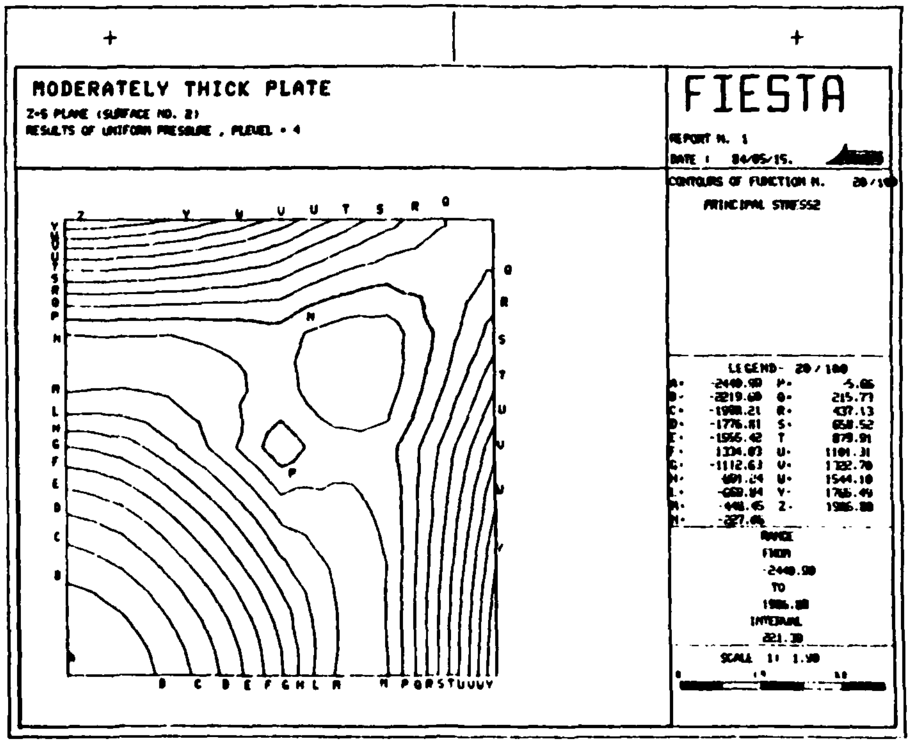


Figure D101. Y-direction principal stress contours for P-level 4 analysis with uniform pressure loading, moderately thick plate

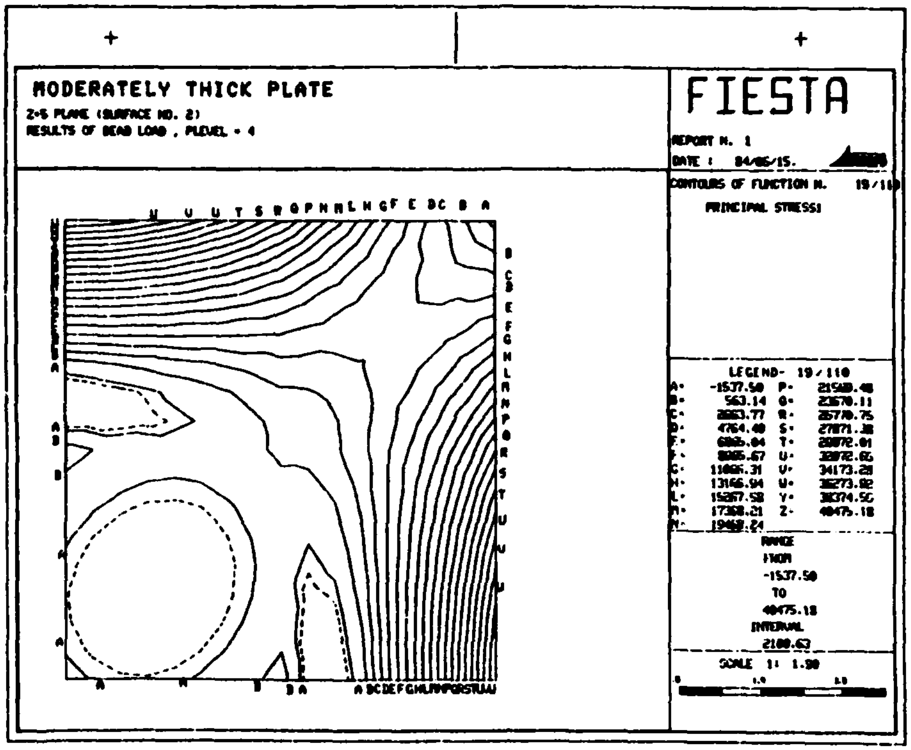


Figure D102. X-direction principal stress contours for P-level 4 analysis with dead loading, moderately thick plate

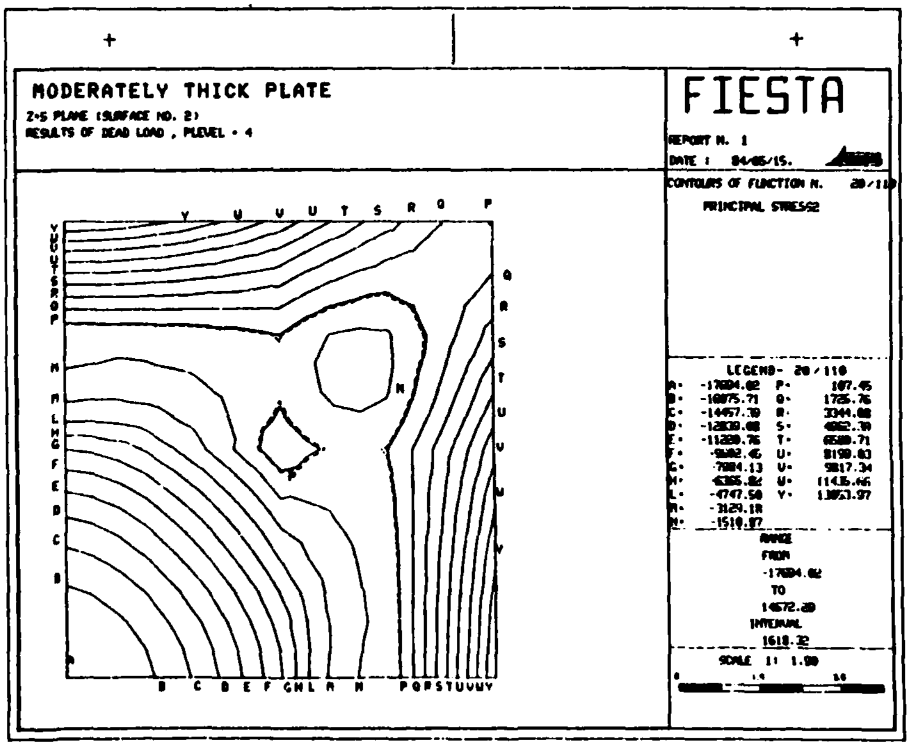


Figure D103. Y-direction principal stress contours for P-level 4 analysis with dead loading, moderately thick plate

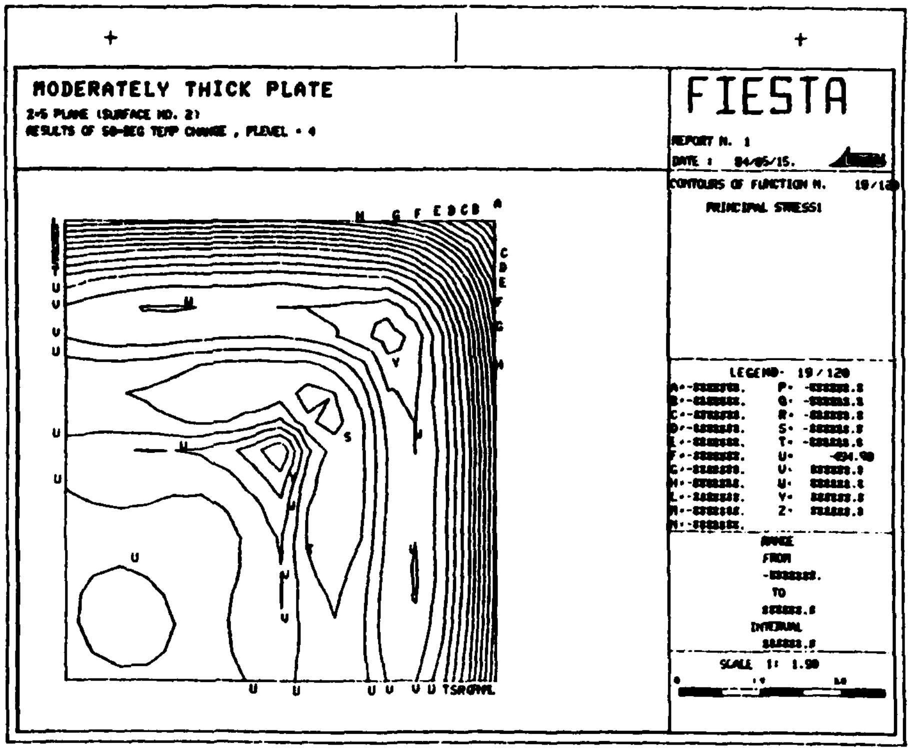


Figure D104. X-direction principal stress contours for P-level 4 analysis with temperature loading, moderately thick plate

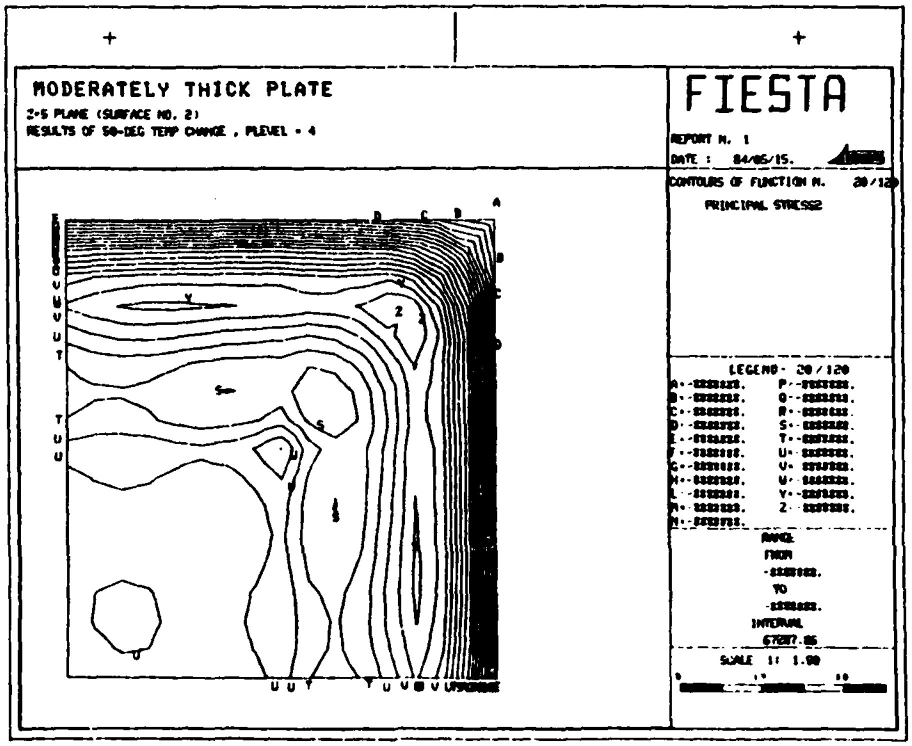


Figure D105. Y-direction principal stress contours for P-level 4 analysis with temperature loading, moderately thick plate

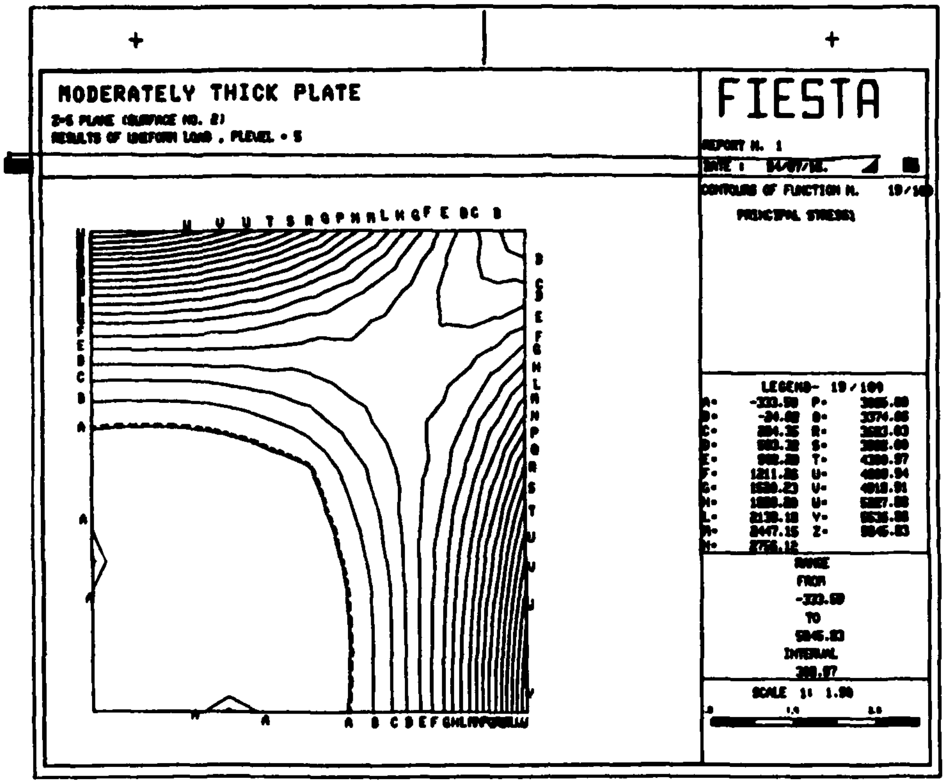


Figure D106. X-direction principal stress contours for P-level 5 analysis with uniform pressure loading, moderately thick plate

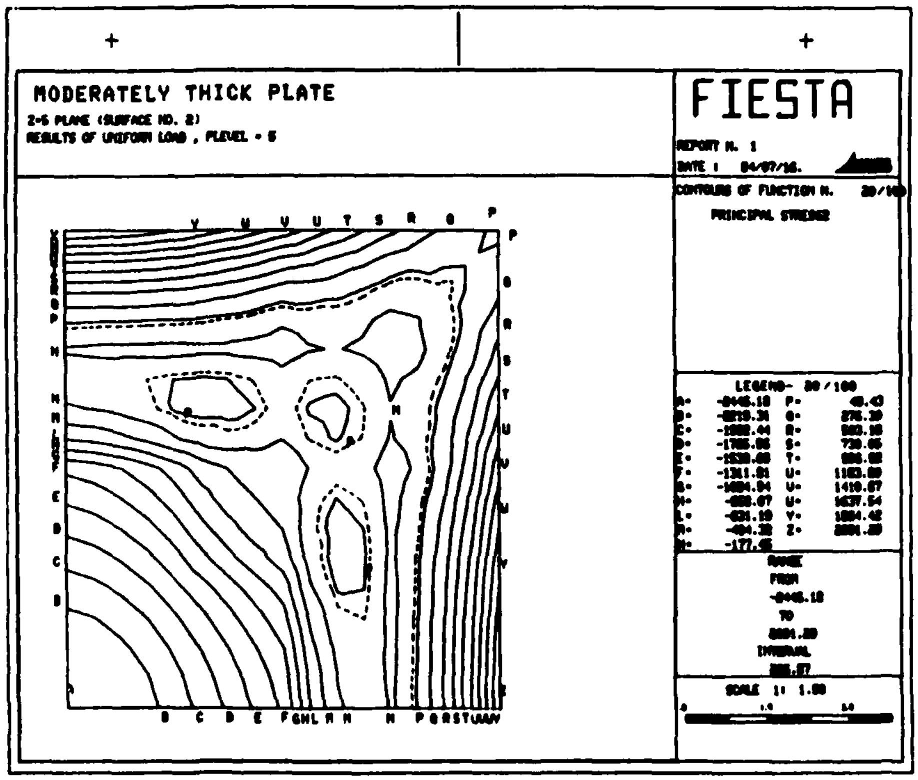


Figure D107. Y-direction principal stress contours for P-level 5 analysis with uniform pressure loading, moderately thick plate

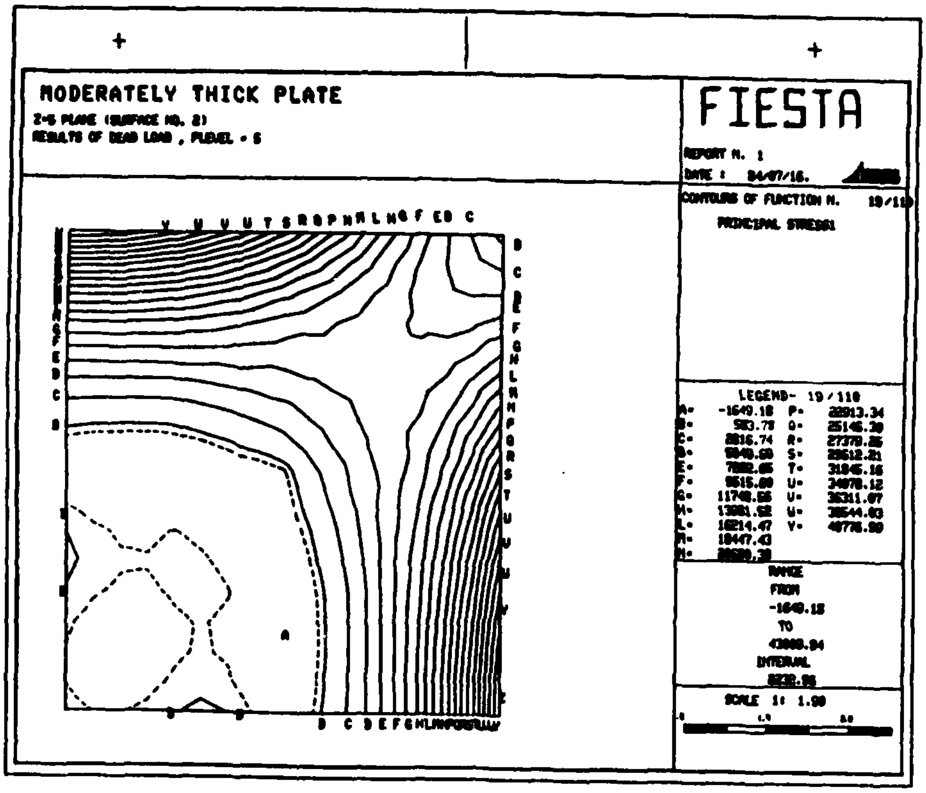


Figure D108. X-direction principal stress contours for P-level 5 analysis with dead loading, moderately thick plate

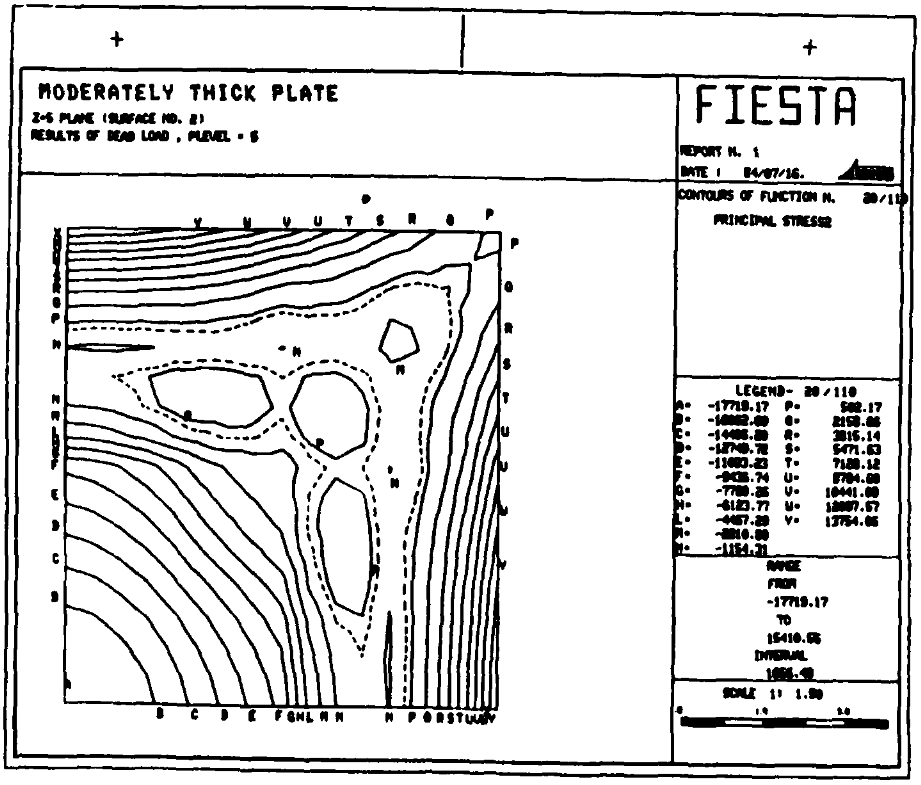


Figure D109. Y-direction principal stress contours for P-level 5 analysis with dead loading, moderately thick plate

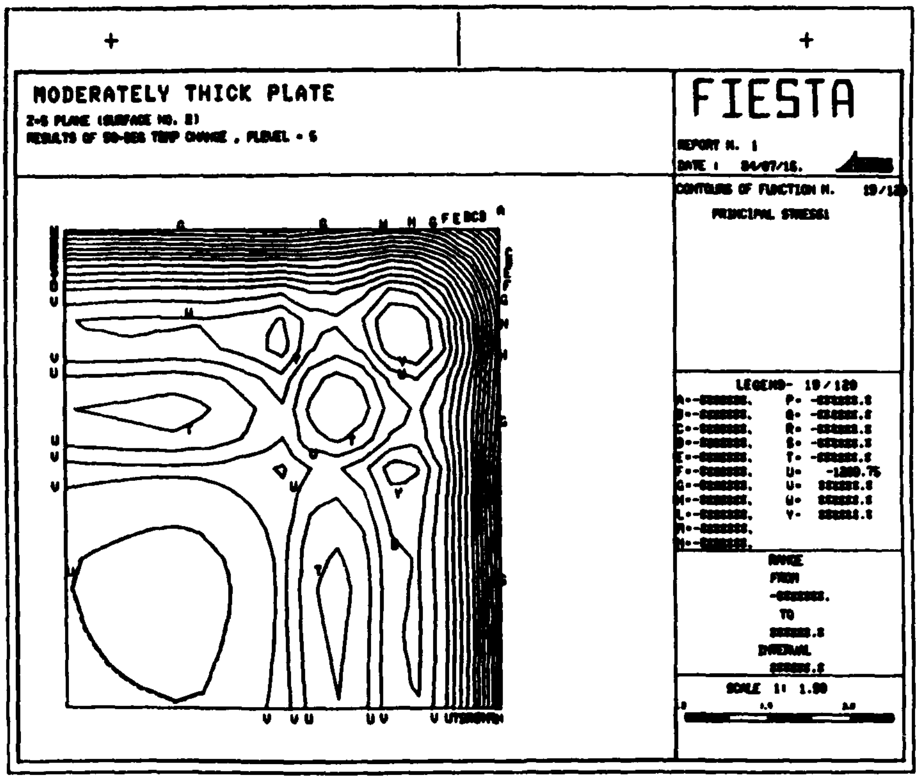


Figure D110. X-direction principal stress contours for P-level 5 analysis with temperature loading, moderately thick plate

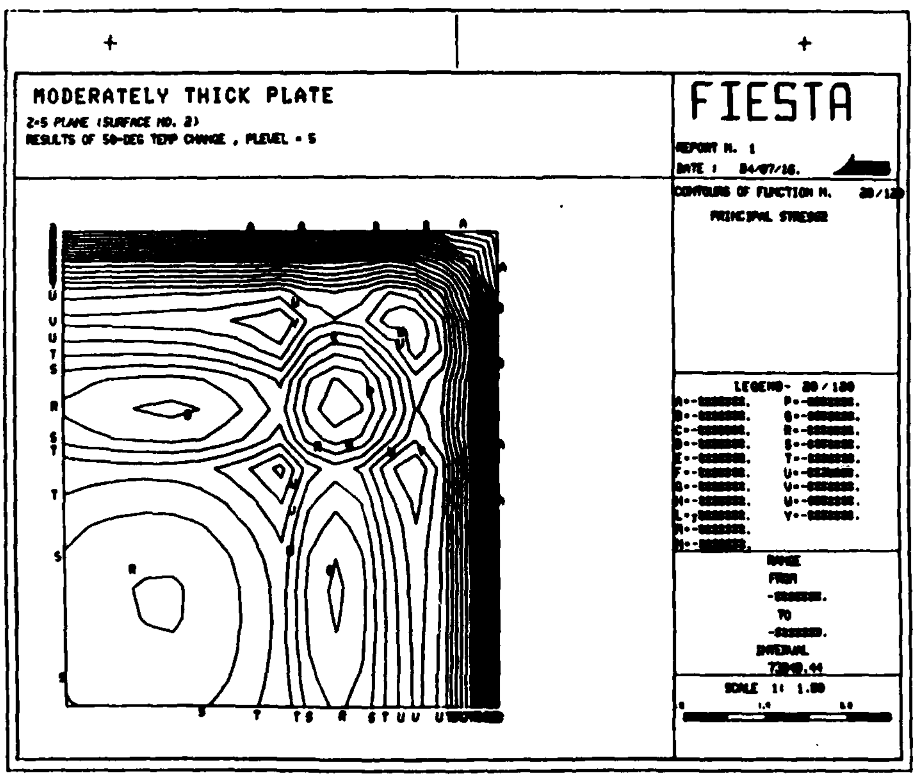


Figure D111. Y-direction principal stress contours for P-level 5 analysis with temperature loading, moderately thick plate

APPENDIX E: HAND CALCULATIONS FOR THEORETICAL THIN PLATE DEFLECTIONS

1. This appendix gives details regarding thin plate theoretical center deflection calculations for the 100-psf uniform loads. These details are listed below:

a. Reference book: Theory of Plates and Shells (Timoshenko and Woinowsky-Krieger 1959, 2nd ed., pp 197-202).

$$\delta_{max} \quad \frac{-0.00126(q)(a^4)}{D} \qquad \text{for } \frac{b}{a} = 1 \text{ and uniform loads}$$

with

$$D = \frac{Eh^3}{12\,(1 - \mu^2)}$$

b. The thin plate being analyzed is 20 ft sq, 0.5 ft thick, has 100-psf uniform load on the entire plate and is fixed on all edges.

$$\begin{matrix} q = 100 \text{ psf} \\ a = 20 \text{ ft} \\ b = 20 \text{ ft} \end{matrix} \quad \left\{ \begin{matrix} h = 0.5 \text{ ft} \\ E = 4.176 \text{ E9 psf} \\ \mu = 0.27 \end{matrix} \right\} \quad \text{values used in finite element model (FEM) analysis}$$

$$\frac{b}{a} = 1$$

$$D = \frac{4.176 \text{ E9 } (0.5^3)}{12\,(1 - 0.27^2)} = 46920504.8$$

$$\delta_{max} = -0.00126 \,\frac{(100)\,(20^4)}{46920504.8} = -0.0004297 \text{ ft}$$

$$\delta_m = \underline{-0.4297 \text{ E } -3 \text{ ft}}$$

2. The same thin plate described on page E2 is reused for calculation of center deflection due to dead weight and these calculations follow.

a. Convert the dead weight (lb/ft^3) to an equivalent uniform load.

$$\text{Density} = 15.2174 \frac{lb\text{-}sec^2}{ft^4} \text{ (from computer analysis)}$$

$$\gamma = \text{Density} \times g = 15.2174 \frac{lb\text{-}sec^2}{ft^4} \; 32.2 \frac{ft}{sec^2}$$

$$\gamma = 490.00028 \; lb/ft^3$$

Plate thickness $t = 0.5$ ft

$$q \text{ equivalent} = 490.00028 \; lb/ft^3 \; (0.5 \; ft) - 245.00014 \; psf$$

b. Deflection calculation

$$\delta_{max} = -0.00216 \frac{245.00014 \; (20^3)}{46920504.8} = -0.0010526747 \; ft$$

$$\delta_{max} = \underline{-0.10528 \text{ E } -2 \text{ ft}}$$

APPENDIX F: HAND CALCULATIONS OF PERCENT ERROR FOR THIN PLATE DISPLACEMENTS

Calculation of Percent Error for Thin Plate Displacements

100-psf loading

δ theoretical = -0.0004297 ft (from Appendix E, page E2)

$$\text{error} = \frac{\text{theoretical - calculated}}{\text{theoretical}} \times 100$$

FIESTA

$$\underset{16\ \text{DoF*}}{\text{Error (P-level 1)}} = \frac{-0.0004297 + 0.000016823}{-0.0004297} \times 100 = 96.08\%$$

$$\underset{64\ \text{DoF}}{\text{Error (P-level 2)}} = \frac{-0.0004297 + 0.00025167}{-0.0004297} \times 100 = 41.43\%$$

$$\underset{108\ \text{DoF}}{\text{Error (P-level 3)}} = \frac{-0.0004297 + 0.00034788}{-0.0004297} \times 100 = 19.04\%$$

$$\underset{156\ \text{DoF}}{\text{Error (P-level 4)}} = \frac{-0.0004297 + 0.00042010}{-0.0004297} \times 100 = 2.23\%$$

$$\underset{244\ \text{DoF}}{\text{Error (P-level 5)}} = \frac{-0.0004297 + 0.00042906}{-0.0004297} \times 100 = 0.15\%$$

GTSTRUDL

$$\underset{227\ \text{DoF}}{\text{error}} = \left| \frac{-0.0004297 + 0.0004354}{-0.0004297} \right| \times 100 = 1.33\%$$

Assume straight line between P-levels 4 and 5, then calculate displacement and percent error for FIESTA with DoF = 227 .

$$\frac{\Delta Z}{227 - 156} = \frac{0.00042906 - 0.0004201}{244 - 156}$$

$$\Delta Z = 0.0000072291$$

$$\text{Z displacement} = -0.0004201 - 0.0000072291$$

---

* Degrees of freedom (DoF).

$$Z = -0.0004273291 \text{ ft}$$

$$\text{error} = \frac{-0.0004297 + 0.0004273291}{-0.0004297} \times 100$$

error = 0.55% (still less than GTSTRUDL)

<u>Dead load</u>

δ theoretical = -0.0010527 ft (from Appendix E, page E3)

FIESTA

$$\underset{16 \text{ DoF}}{\text{Error (P-level 1)}} = \frac{-0.0010527 + 0.000041216}{-0.0010527} \times 100 = 96.08\%$$

$$\underset{64 \text{ DoF}}{\text{Error (P-level 2)}} = \frac{-0.0010527 + 0.00061676}{-0.0010527} \times 100 = 41.41\%$$

$$\underset{108 \text{ DoF}}{\text{Error (P-level 3)}} = \frac{-0.0010527 + 0.00085234}{-0.0010527} \times 100 = 19.03\%$$

$$\underset{156 \text{ DoF}}{\text{Error (P-level 4)}} = \frac{-0.0010527 + 0.0010293}{-0.0010527} \times 100 = 2.22\%$$

$$\underset{244 \text{ DoF}}{\text{Error (P-level 5)}} = \frac{-0.0010527 + 0.0010513}{-0.0010527} \times 100 = 0.13\%$$

GTSTRUDL

$$\underset{227 \text{ DoF}}{\text{Error}} = \frac{-0.0010527 + 0.0010666}{-0.0010527} \times 100 = 1.32\%$$

Calculate FIESTA results for DoF = 227 (same as procedure on page F2)

$$\frac{\Delta Z}{227 - 156} = \frac{0.0010513 - 0.0010293}{244 - 156}$$

$$\Delta Z = 0.00001775$$

$$Z = -0.0010293 - 0.00001775$$

$$Z = -0.00104705 \text{ ft}$$

$$\text{error} = \frac{-0.0010527 + 0.00104705}{-0.0010527} \times 100$$

error = 0.54% (still less than GTSTRUDL)

Moderately Thick and Thick Plate Results

	FIESTA (Displacement)					GTSTRUDL (Displacement)
	P-level 1	P-level 2	P-level 3	P-level 4	P-level 5	
Moderately Thick Plate						
100-psf uniform load	-0.0000046111	-0.000014662	-0.00001567	-0.000017014	-0.000017281	-0.0000174
Dead load	-0.000033891	-0.000108	-0.00011526	-0.00012516	-0.00012708	-0.0001277
Degrees of freedom	16	64	108	156	244	227
Thick Plate						
100-psf uniform load	-0.00000065807	-0.00000078274	-0.00000080154	-0.0000008443	-0.00000085527	-0.0000008
Dead load	-0.000016123	-0.000019511	-0.000019851	-0.000020888	-0.000021122	-0.0000199
Degrees of freedom	16	64	108	156	244	227

Moderately thick plate

Calculate Z for DoF = 227 for FIESTA (use same method as used on page F2)

100-psf uniform load

$$\Delta Z = (227 - 156)\ \frac{0.000017281 - 0.000017014}{244 - 156}$$

$$\Delta Z = 0.0000002154$$

$$Z = -0.000017014 - 0.0000002154 = -0.0000172294$$

Difference between GTSTRUDL and FIESTA = <u>0.00000017 ft</u>

Dead load

$$\Delta Z = (227 - 156)\ \frac{0.00012708 - 0.00012516}{244 - 156} = 0.0000015491$$

$$Z = 0.00012516 + 0.0000015491 = -0.0001267091$$

Difference between GTSTRUDL and FIESTA = <u>0.00000099 ft</u>

Thick plate

100-psf uniform load

$$\Delta Z = (227 - 156)\ \frac{0.00000085527 - 0.0000008443}{244 - 156} = 0.0000000088$$

$$Z = 0.0000008443 + -0.0000000088 = -0.0000009$$

Difference between GTSTRUDL and FIESTA = <u>-0.0000001 ft</u>

Dead load

$$\Delta Z = (227 - 156)\ \frac{0.000021122 - 0.000020888}{244 - 156} = 0.0000001888$$

$$Z = 0.000020888 + 0.0000001888 = -0.0000210768$$

Difference between GTSTRUDL and FIESTA = <u>-0.0000011768 ft</u>

Cost of Thin Plate Analysis

Overnight priority (POO)

P-level 4 128.010* AJ's × 0.10 \$/AJ = \$12.80

P-level 5 215.151* AJ's × 0.10 \$/AJ = \$21.52

Find interpolate FIESTA cost for 227 DoF

$$\text{Cost} = (227 - 156)\,\frac{21.52 - 12.80}{244 - 156} + 12.80 = \underline{\$\ 19.84}$$

Cost for GTSTRUDL

Overnight priority

Cost = 31.668** units × 0.007 \$/unit = \$0.22

This is about 90 percent of the total cost, so round the cost of total GTSTRUDL analysis to **\$0.25**

---

* From FIESTA day files.
** From GTSTRUDL day files.

APPENDIX G: ASPECT RATIO FILES AND PLOTS

```
B2N4I      08:11 MAY 08,'84

*TOP
BEAM - ASPECT RATIO = 10.67 , PLEVEL = 2
1 0. 0. 0 0
5 0. 1.5 0. ,, 1 5 1.
10 4. 0. 0. ,, 5 2 1.
20 0. 0. 1. ,, 10 2 1.
END OF COORDINATES
31 1 1 6 7 2 11 16 17 12
-1 4 1 0 0 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
*SURF
1
10
*MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT      GRID I N = 4
END OF PLOT DATA
*CHECK
*CONST
3 0 2 3
5
3 0 1 3
3
END OF CONST
*PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.6E-6
END OF MAT PROP
*PLEVEL
2
ALL
END OF PLEVEL DEF
NO LIST
*LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 10 -28800.
1 52 -28800.
1 20 -28800.
1 49 -25200.
1 54 -25200.
1 9 -21600.
1 44 -21600.
1 19 -21600.
1 41 -18000.
1 46 -18000.
1 8 -14400.
1 36 -14400.
1 18 -14400.
1 33 -10800.
1 28 -10800.
1 7 -7200.
1 27 -7200.
1 17 -7200.
1 22 -3600.
1 30 -3600.
1 6 0.
1 26 0.
1 16 0.
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
*LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
*LOVE
*ARRAY
*STIFF
*STATIC
*SOLVE
*DISP
*STRESS
0
ALL
ALL
*AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
*CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
*CDATA
100 11 0 1 0 1
GRID I  ,  N = 4
END OF CDATA
*CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0. 5.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
*ENDP
$
```

Figure G1. Grid I, N = 4 , P-level 2 data file

```
B4N4I        08:14 MAY 08,'84

%TOP
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5 0. 1.5 0. ., 1 5 1.
10 4. 0. 0. ., 5 2 1.
20 0. 0. 1. ., 10 2 1.
END OF COORDINATES
31 1 1 6 7 2 11 16 17 12
-1 4 1 0 0 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
%SURF
1
10
%MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT       GRID I N = 4
END OF PLOT DATA
%CHECK
%CONST
3 0 2 3
5
3 0 1 3
3
END OF CONST
%PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.6E-6
END OF MAT PROP
%PLEVEL
4
ALL
END OF PLEVEL DEF
NO LIST
%LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 10 -28800.
1 52 -28800.
1 50 -28800.
1 49 -25200.
1 54 -25200.
1 9 -21600.
1 44 -21600.
1 19 -21600.
1 41 -18000.
1 46 -18000.
1 8 -14400.
1 36 -14400.
1 18 -14400.
1 33 -10800.
1 28 -10800.
1 7 -7200.
1 27 -7200.
1 17 -7200.
1 22 -3600.
1 30 -3600.
1 6 0.
1 26 0.
1 16 0.
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
%LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
%LOVE
%ARRAY
%STIFF
%STATIC
%SOLVE
%DISP
%STRESS
0
ALL
ALL
%AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
%CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
%CDATA
100 11 0 1 0 1
GRID I    , N = 4
END OF CDATA
%CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0. 5.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
%ENDP
$
```

Figure G2. Grid I, N = 4 , P-level 4 data file

```
BEN4II      08:18 MAY 08,'84

$TOP
BEAM - ASPECT RATIO = 10.67 , PLEVEL = 2
1 0. 0. 0. 0
5 0. 1.5 0. ., 1 5 1.
15 4. 0. 0. ., 5 3 1.
30 0. 0. 1. ., 15 2 1.
END OF COORDINATES
31 1 1 6 7 2 16 21 22 17
-1 2 5 4 1 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
$SURF
1
10
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT       GRID II , N = 4
END OF PLOT DATA
$CHECK
$CONST
3 0 2 3
4
3 0 1 3
3
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.6E-6
END OF MAT PROP
$PLEVEL
2
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 15 -28800.
1 30 -28800.
1 57 -28800.
1 86 -25200.
1 88 -25200.
1 14 -21600.
1 29 -21600.
1 74 -21600.
1 72 -18000.
1 75 -18000.
1 13 -14400.
1 61 -14400.
1 28 -14400.
1 59 -10800.
1 62 -10800.
1 12 -7200.
1 27 -7200.
1 47 -7200.
1 44 -3600.
1 49 -3600.
1 11 0.
1 26 0.
1 46 0.
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
$LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
$CDATA
100 11 0 1 0 1
GRID II   ,   N = 4
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0. 5.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure G3. Grid II, N = 4 , P-level 2 data file

```
B4N4II     08:20 MAY 08,'84

*TOP
BEAM - ASPECT RATIO = 10.67 , PLEVEL = 4
1 0. 0. 0. 0
5 0. 1.5 0. ,, 1 5 1.
15 4. 0. 0. ,, 5 3 1.
30 0. 0. 1. ,, 15 2 1.
END OF COORDINATES
31 1 1 6 7 2 16 21 22 17
-1 2 5 4 1 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
*SURF
1
10
*MPLOT
1
101 5 1 1 1 0 8 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT       GRID II , N = 4
END OF PLOT DATA
*CHECK
*CONST
3 0 2 3
4
3 0 1 3
3
END OF CONST
*PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.6E-6
END OF MAT PROP
*PLEVEL
4
ALL
END OF PLEVEL DEF
NO LIST
*LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 15 -28800.
1 20 -28800.
1 87 -28800.
1 85 -25200.
1 88 -25200.
1 14 -21600.
1 29 -21600.
1 74 -21600.
1 72 -18000.
1 75 -18000.
1 13 -14400.
1 61 -14400.
1 28 -14400.
1 59 -10800.
1 62 -10800.
1 12 -7200.
1 27 -7200.
1 47 -7200.
1 44 -3600.
1 49 -3600.
1 11 0.
1 26 0.
1 46 0.
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
*LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
*LOVE
*ARRAY
*STIFF
*STATIC
*SOLVE
*DISP
*STRESS
0
ALL
ALL
*AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
*CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
*CDATA
100 11 0 1 0 1
GRID II   ,   N = 4
END OF CDATA
*CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0. 5.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
*ENDP
$
```

Figure G4. Grid II, N = 4 , P-level 4 data file

```
$2N101     12:56 MAY 11.'84

$TOP
BEAM - ASPECT RATIO = 26.67 . PLEVEL = 2
1 0. 0. 0  0
11 0  1.5 0. .. 1 11 1.
22 4. 0. 0. .. 11 2 1.
44 0. 0. 1  .. 22 2 1.
END OF COORDINATES
31 1 1 12 13 2 23 34 35 24
-1 10 1 0 0 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
$SURF
1
10
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT       GRID I . N = 10
END OF PLOT DATA
$CHECK
$CONST
3 0 2 3
5
3 0 1 3
3
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.6E-6
END OF MAT PROP
$PLEVEL
2
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 22 -28800.
1 44 -28800.
1 124 -28800.
1 121 -27360.
1 126 -27360.
1 21 -25920.
1 43 -25920.
1 116 -25920.
1 113 -24480.
1 118 -24480.
1 20 -23040.
1 42 -23040.
1 108 -23040.
1 105 -21600.
1 110 -21600.
1 19 -20160
1 41 -20160
1 100 -20160
1 97 -18720
1 102 -18720
1 18 -17280
1 40 -17280
1 92 -17280.
1 89 -15840
1 94 -15840.
1 17 -14400.
1 39 -14400.
1 84 -14400.
1 81 -12960.
1 86 -12960.
1 16 -11520.
1 38 -11520.
1 76 -11520.
1 73 -10080.
1 78 -10080.
1 15 -8640.
1 37 -8640
1 68 -8640
1 65 -7200.
1 70 -7200.
1 14 -5760.
1 36 -5760.
1 60 -5760.
1 57 -4320.
1 62 -4320.
1 13 -2880.
1 35 -2880.
1 51 -2880.
1 46 -1440.
1 54 -1440.
1 12 0.
1 34 0
1 50 0.
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
$LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0  0  5
3
1
END OF CMESH
$CDATA
100 11 0 1 0 1
GRID I . N = 10
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0 5.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure G5. Grid I, N = 10 , P-level 2 data file

```
B4N10I     07:31 MAY 14,'84

00100 $TOP
00110 BEAM - ASPECT RATIO = 26.67 , PLEVEL = 4
00120 1 0 0. 0. 0
00130 11 0 1 5 0. .. 1 11 1.
00140 22 4. 0 0. .. 11 2 1
00150 44 0. 0. 1. .. 22 2 1.
00160 END OF COORDINATES
00170 31 1 1 12 13 2 23 34 35 24
00180 -1 10 1 0 0 0 0
00190 END OF INCIDENCES
00200 NO LOCAL COORDINATES
00210 0
00220 NO EQUIVALENTING
00230 0
00240 $SURF
00250 1
00260 10
00270 $MPLOT
00280 1
00290 101 5 1 1 1 0 2 0 0 0
00300 -60. 15 15.
00310 END PLOT ID
00320 4
00330 1 101 0 0 0
00340 GEOMETRY PLOT      GRID I , N = 10
00350 END OF PLOT DATA
00360 $CHECK
00370 $CONST
00380 3 0 2 3
00390 5
00400 3 0 1 3
00410 3
00420 END OF CONST
00430 $PROP
00440 1
00450 ALL
00460 END OF MATERIAL DISP
00470 1 0 0
00480 4.32E9 .3
00490 15.2174 6.6E-6
00500 END OF MAT PROP
00510 $PLEVEL
00520 4
00530 ALL
00540 END OF PLEVEL DEF
00550 NO LIST
00560 $LOADS
00570 1
00580 LINEARLY VARIABLE PRESSURE
00590 4
00600 1 22 -28800.
00610 1 44 -28800.
00620 1 124 -28800.
00630 1 121 -27360.
00640 1 126 -27360.
00650 1 21 -25920.
00660 1 43 -25920.
00670 1 116 -25920.
00680 1 113 -24480.
00690 1 118 -24480.
00700 1 20 -23040.
00710 1 42 -23040.
00720 1 108 -23040.
00730 1 105 -21600.
00740 1 110 -21600.
00750 1 19 -20160.
00760 1 41 -20160.
00770 1 100 -20160.
00780 1 97 -18720.
00790 1 102 -18720.
00800 1 18 -17280.
00810 1 40 -17280.
00820 1 92 -17280.
00830 1 89 -15840.
00840 1 94 -15840.
00850 1 17 -14400.
00860 1 39 -14400.
00870 1 84 -14400.
00880 1 81 -12960.
00890 1 86 -12960.
00900 1 16 -11520.
00910 1 38 -11520.
00920 1 76 -11520.
00930 1 73 -10080.
00940 1 78 -10080.
00950 1 15 -8640.
00960 1 37 -8640.
00970 1 68 -8640.
00980 1 65 -7200.
00990 1 70 -7200.
01000 1 14 -5760.
01010 1 36 -5760.
01020 1 60 -5760.
01030 1 57 -4320.
01040 1 62 -4320.
01050 1 13 -2880.
01060 1 35 -2880.
01070 1 51 -2880.
01080 1 46 -1440.
01090 1 54 -1440.
01100 1 12 0.
01110 1 34 0.
01120 1 50 0.
01130 END OF PRESSURES
01140 END OF LOAD CASE 1
01150 END OF LOADS
01160 $LCOMB
01170 11
01180 LOAD COMBINATION 1
01190 1 1
01200 END OF LOAD COMBINATION 1
01210 END OF LOAD COMB DEF
01220 $LOVE
01230 $ARRAY
01240 $STIFF
01250 $STATIC
01260 $SOLVE
01270 $DISP
01280 $STRESS
01290 0
01300 ALL
01310 ALL
01320 $AXES
01330 10 0 0
01340 0. 0. 0. 0
01350 END OF LOCAL AXES SYSTEM = 10
01360 $CMESH
01370 1
01380 SURFACE NUMBER 1 ( Z = 0 PLANE )
01390 2 0 1
01400 0 0 5
01410 3
01420 1
01430 END OF CMESH
01440 $CDATA
01450 100 11 0 1 0 1
01460 GRID I . N = 10
01470 END OF CDATA
01480 $CPLOT
01490 1
01500 200 5 0 1 1 0 1 0 0
01510 0 0 5
01520 END PLOTID
01530 6
01540 19 100 200 0 0 0 0 0
01550 PRINCIPAL STRESS1
01560 20 100 200 0 0 0 0 0
01570 PRINCIPAL STRESS2
01580 END OF PLOT DATA
01590 $ENDP
$
```

Figure G6. Grid I, N = 10 , P-level 4 data file

```
B2N10II    10:03 MAY 08,'84

%TOP
BEAM - ASPECT RATIO = 13.33 , PLEVEL = 2
1 0. 0. 0. 0
11 0. 1.5 0. ,, 1 11 1.
33 4. 0. 0. ,, 11 3 1.
66 0. 0. 1. ,, 33 2 1.
END OF COORDINATES
31 1 1 12 13 2 34 45 46 35
-1 2 11 10 1 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
%SURF
1
10
%MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT      GRID II , N = 10
END OF PLOT DATA
%CHECK
%CONST
3 0 2 3
4
3 0 1 3
3
END OF CONST
%PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.6E-6
END OF MAT PROP
%PLEVEL
2
ALL
END OF PLEVEL DEF
NO LIST
%LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 33 -28800.
1 66 -28800.
1 201 -28800.
1 199 -27360.
1 202 -27360.
1 32 -25920.
1 65 -25920.
1 188 -25920.
1 186 -24480.
1 189 -24480.
1 31 -23040.
1 64 -23040.
1 175 -23040.
1 173 -21600.
1 176 -21600.
1 30 -20160.
1 63 -20160.
1 162 -20160.
1 160 -18720.
1 163 -18720.
1 29 -17280.
1 62 -17280.
1 149 -17280.
1 147 -15840.
1 150 -15840.
1 28 -14400.
1 61 -14400.
1 136 -14400.
1 134 -12960.
1 137 -12960.
1 27 -11520.
1 60 -11520.
1 123 -11520.
1 121 -10080.
1 124 -10080.
1 26 -8640.
1 59 -8640.
1 110 -8640.
1 108 -7200.
1 111 -7200.
1 25 -5760.
1 58 -5760.
1 97 -5760.
1 95 -4320.
1 98 -4320.
1 24 -2880.
1 57 -2880.
1 83 -2880.
1 80 -1440.
1 85 -1440.
1 23 0.
1 56 0.
1 82 0.
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
%LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
%LOVE
%ARRAY
%STIFF
%STATIC
%SOLVE
%DISP
%STRESS
0
ALL
ALL
%AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
%CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
%CDATA
100 11 0 1 0 1
GRID II  ,  N = 10
END OF CDATA
%CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0. 5.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
%ENDP
%
```

Figure G7. Grid II, N = 10 , P-level 2 data file

```
B4N10II    10:01 MAY 08,'84

*TOP
BEAM - ASPECT RATIO = 13.33 , PLEVEL = 4
1 0. 0. 0. 0
11 0. 1.5 0. ., 1 11 1.
33 4. 0. 0. ., 11 3 1.
66 0. 0. 1. ., 33 2 1.
END OF COORDINATES
31 1 1 12 13 2 34 45 46 35
-1 2 11 10 1 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
*SURF
1
10
*MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT       GRID II , N = 10
END OF PLOT DATA
*CHECK
*CONST
3 0 2 3
4
3 0 1 3
3
END OF CONST
*PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.6E-6
END OF MAT PROP
*PLEVEL
4
ALL
END OF PLEVEL DEF
NO LIST
*LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 33 -28800.
1 66 -28800.
1 201 -28800.
1 199 -27360.
1 202 -27360.
1 32 -25920.
1 65 -25920.
1 188 -25920.
1 186 -24480.
1 189 -24480.
1 31 -23040.
1 64 -23040.
1 175 -23040.
1 173 -21600.
1 176 -21600.
1 30 -20160.
1 63 -20160.
1 162 -20160.
1 160 -18720.
1 163 -18720.
1 29 -17280.
1 62 -17280.
1 149 -17280.
1 147 -15840.
1 150 -15840.
1 28 -14400.
1 61 -14400.
1 136 -14400.
1 134 -12960.
1 137 -12960.
1 27 -11520.
1 60 -11520.
1 123 -11520.
1 121 -10080.
1 124 -10080.
1 26 -8640.
1 59 -8640.
1 110 -8640.
1 108 -7200.
1 111 -7200.
1 25 -5760.
1 58 -5760.
1 97 -5760.
1 95 -4320.
1 98 -4320.
1 24 -2880.
1 57 -2880.
1 83 -2880.
1 80 -1440.
1 85 -1440.
1 23 0.
1 56 0.
1 82 0.
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
*LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
*LOVE
*ARRAY
*STIFF
*STATIC
*SOLVE
*DISP
*STRESS
0
ALL
ALL
*AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
*CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
*CDATA
100 11 0 1 0 1
GRID II  ,  N = 10
END OF CDATA
*CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0. 5.
END PLOTID
6
10 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
*ENDP
*
```

Figure G8. Grid II, N = 10 , P-level 4 data file

```
B2N20I     07:16 MAY 10,'84

$TOP
BEAM - ASPECT RATIO = 53.33 , PLEVEL = 2
1 0  0  0  0
21 0  1 5 0  ., 1 21 1.
42 4  0. 0.  .. 21 2 1
84 0  0. 1.  .. 42 2 1.
END OF COORDINATES
31 1 1 22 23 2 43 64 65 44
-1 20 1 0 0 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
$SURF
1
10
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60  15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT       GRID I , N = 20
END OF PLOT DATA
$CHECK
$CONST
3 0 2 3
5
3 0 1 3
3
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.6E-6
END OF MAT PROP
$PLEVEL
2
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 42 -28800.
1 84 -28800.
1 244 -28800.
1 241 -28080.
1 246 -28080.
1 41 -27360
1 83 -27360.
1 236 -27360.
1 233 -26640.
1 238 -26640.
1 40 -25920.
1 82 -25920.
1 228 -25920.
1 225 -25200.
1 230 -25200.
1 39 -24480.
1 81 -24480.
1 220 -24480
1 217 -23760.
1 222 -23760.
1 38 -23040.
1 80 -23040.
1 212 -23040.
1 209 -22320.
1 214 -22320.
1 37 -21600.
1 79 -21600
1 204 -21600.
1 201 -20880.
1 206 -20880.
1 36 -20160.
1 78 -20160
1 196 -20160.
1 193 -19440.
1 198 -19440
1 35 -18720
1 77 -18720
1 188 -18720.
1 185 -18000
1 190 -18000.
1 34 -17280
1 76 -17280
1 180 -17280.
1 177 -16560
1 182 -16560.
1 33 -15840.
1 75 -15840
1 172 -15840.
1 169 -15120.
1 174 -15120.
1 32 -14400.
1 74 -14400
1 164 -14400
1 161 -13680
1 166 -13680
1 31 -12960.
1 73 -12960.
1 156 -12960.
1 153 -12240
1 158 -12240.
1 30 -11520
1 72 -11520
1 148 -11520
1 145 -10800
1 150 -10800.
1 29 -10080
1 71 -10080
1 140 -10080.
1 137 -9360
1 142 -9360.
1 28 -8640.
1 70 -8640.
1 132 -8640.
1 129 -7920
1 134 -7920.
```

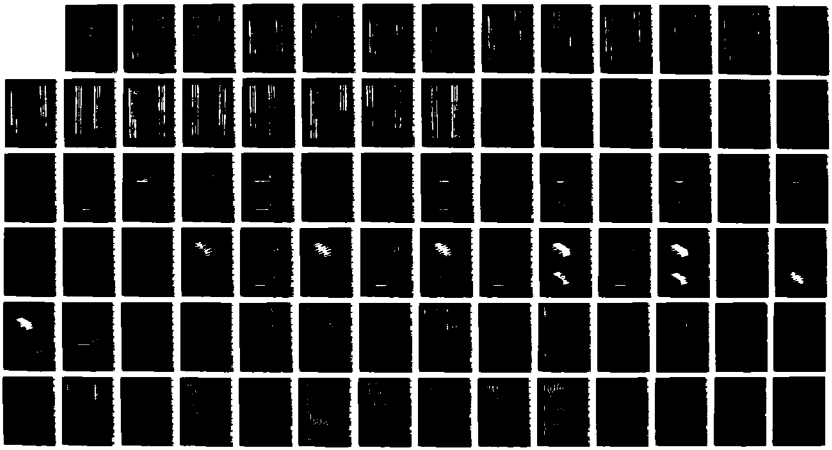
Figure G9. Grid I, N = 20 , P-level 2 data file (Continued)

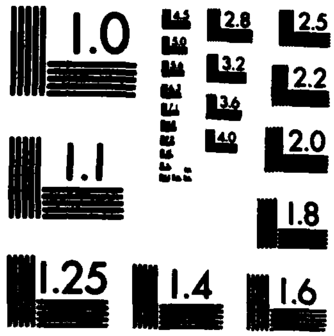
```
1 27 -7200.
1 69 -7200.
1 124 -7200.
1 121 -6480
1 126 -6480
1 26 -5760
1 68 -5760.
1 116 -5760.
1 113 -5040.
1 118 -5040.
1 25 -4320
1 67 -4320
1 108 -4320
1 105 -3600.
1 110 -3600
1 24 -2880
1 66 -2880
1 100 -2880
1 97 -2160
1 102 -2160
1 23 -1440.
1 65 -1440.
1 91 -1440.
1 86 -720
1 94 -720.
1 22 0
1 64 0
1 90 0
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
$LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
$CDATA
100 11 0 1 0 1
GRID I , N = 20
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0. 5.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure G9. (Concluded)

AD-A181 511 EVALUATION OF THE P-LEVEL FINITE-ELEMENT PROGRAM 'FIESTA'(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS INFORMATION TECHNOLOGY LAB 3/3

UNCLASSIFIED R L HALL ET AL. JAN 87 WES/TR/ITL-87-3 F/G 13/2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

```
B4NB0I     07:17 MAY 10,'84

$TOP
BEAM - ASPECT RATIO = 53.33 , PLEVEL = 4
1 0  0. 0  0
21 0  1.5 0. .. 1 21 1.
42 4  0  0. .. 21 2 1.
84 0  0. 1. .. 42 2 1.
END OF COORDINATES
31 1 1 22 23 2 43 64 65 44
-1 20 1 0 0 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
$SURF
1
10
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT       GRID I , N = 20
END OF PLOT DATA
$CHECK
$CONST
3 0 2 3
5
3 0 1 3
3
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15 2174 6 6E-6
END OF MAT PROP
$PLEVEL
4
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 42 -28800.
1 84 -28800.
1 244 -28800.
1 241 -28800.
1 246 -28800.
1 41 -27360.
1 83 -27360.
1 236 -27360.
1 233 -26640.
1 238 -26640.
1 40 -25920.
1 82 -25920.
1 228 -25920.
1 225 -25200.
1 230 -25200.
1 39 -24480.
1 81 -24480.
1 220 -24480.
1 217 -23760.
1 222 -23760.
1 38 -23040.
1 80 -23040.
1 212 -23040.
1 209 -22320.
1 214 -22320.
1 37 -21600.
1 79 -21600.
1 204 -21600.
1 201 -20880.
1 206 -20880.
1 36 -20160.
1 78 -20160.
1 196 -20160.
1 193 -19440.
1 198 -19440.
1 35 -18720.
1 77 -18720.
1 188 -18720.
1 185 -18000.
1 190 -18000.
1 34 -17280.
1 76 -17280.
1 180 -17280.
1 177 -16560.
1 182 -16560.
1 33 -15840.
1 75 -15840.
1 172 -15840.
1 169 -15120.
1 174 -15120.
1 32 -14400.
1 74 -14400.
1 164 -14400
1 161 -13680.
1 166 -13680.
1 31 -12960.
1 73 -12960.
1 156 -12960.
1 153 -12240
1 158 -12240.
1 30 -11520
1 72 -11520.
1 148 -11520.
1 145 -10800.
1 150 -10800.
1 29 -10080.
1 71 -10080.
1 140 -10080.
1 137 -9360.
1 142 -9360.
1 28 -8640.
1 70 -8640.
1 132 -8640.
1 129 -7920.
1 134 -7920.
```

Figure G10. Grid I, N = 20 , P-level 4 data file (Continued)

```
01350 1 27 -7200
01360 1 69 -7200.
01370 1 124 -7200.
01380 1 121 -6480.
01390 1 126 -6480.
01400 1 26 -5760
01410 1 68 -5760.
01420 1 116 -5760.
01430 1 113 -5040
01440 1 118 -5040.
01450 1 25 -4320
01460 1 67 -4320.
01470 1 108 -4320
01480 1 105 -3600.
01490 1 110 -3600.
01500 1 24 -2880.
01510 1 66 -2880.
01520 1 100 -2880.
01530 1 97 -2160.
01540 1 102 -2160.
01550 1 23 -1440.
01560 1 65 -1440.
01570 1 91 -1440.
01580 1 86 -720
01590 1 94 -720.
01600 1 22 0.
01610 1 64 0.
01620 1 90 0.
01630 END OF PRESSURES
01640 END OF LOAD CASE 1
01650 END OF LOADS
01660 $LCOMB
01670 11
01680 LOAD COMBINATION 1
01690 1 1
01700 END OF LOAD COMBINATION 1
01710 END OF LOAD COMB DEF
01720 $LOVE
01730 $ARRAY
01740 $STIFF
01750 $STATIC
01760 $SOLVE
01770 $DISP
01780 $STRESS
01790 0
01800 ALL
01810 ALL
01820 $AXES
01830 10 0 0
01840 0. 0. 0. 0
01850 END OF LOCAL AXES SYSTEM = 10
01860 $CMESH
01870 1
01880 SURFACE NUMBER 1 ( Z = 0 PLANE )
01890 2 0 1
01900 0. 0. 5.
01910 3
01920 1
01930 END OF CMESH
01940 $CDATA
01950 100 11 0 1 0 1
01960 GRID I , N = 20
01970 END OF CDATA
01980 $CPLOT
01990 1
02000 200 5 0 1 1 0 1 0 0
02010 0. 0. 5.
02020 END PLOTID
02030 6
02040 19 100 200 0 0 0 0 0
02050 PRINCIPAL STRESS1
02060 20 100 200 0 0 0 0 0
02070 PRINCIPAL STRESS2
02080 END OF PLOT DATA
02090 $ENDP
$
```

Figure G10. (Concluded)

```
B2N20II    10:38 MAY 08,'84

$TOP
BEAM - ASPECT RATIO = 26.67 , PLEVEL = 2
1 0. 0. 0. 0
21 0. 1.5 0. ., 1 21 1.
63 4. 0. 0. ., 21 3 1.
126 0. 0. 1. ., 63 2 1.
END OF COORDINATES
31 1 1 22 23 2 64 85 86 65
-1 2 21 20 1 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
$SURF
1
10
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT      GRID II , N = 20
END OF PLOT DATA
$CHECK
$CONST
3 0 2 3
4
3 0 1 3
3
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.6E-6
END OF MAT PROP
$PLEVEL
2
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 63 -28800.
1 126 -28800.
1 391 -28800.
1 389 -28080.
1 392 -28080.
1 62 -27360.
1 125 -27360.
1 378 -27360.
1 376 -26640.
1 379 -26640.
1 61 -25920.
1 124 -25920.
1 365 -25920.
1 363 -25200.
1 366 -25200.
1 60 -24480.
1 123 -24480.
1 352 -24480.
1 350 -23760.
1 353 -23760.
1 59 -23040.
1 122 -23040.
1 339 -23040.
1 337 -22320.
1 340 -22320.
1 58 -21600.
1 121 -21600.
1 326 -21600.
1 324 -20880.
1 327 -20880.
1 57 -20160.
1 120 -20160.
1 313 -20160.
1 311 -19440.
1 314 -19440.
1 56 -18720.
1 119 -18720.
1 300 -18720.
1 298 -18000.
1 301 -18000.
1 55 -17280.
1 118 -17280.
1 287 -17280.
1 285 -16560.
1 288 -16560.
1 54 -15840.
1 117 -15840.
1 274 -15840.
1 272 -15120.
1 275 -15120.
1 53 -14400.
1 116 -14400.
1 261 -14400.
1 259 -13680.
1 262 -13680.
1 52 -12960.
1 115 -12960.
1 248 -12960.
1 246 -12240.
1 249 -12240.
1 51 -11520.
1 114 -11520.
1 235 -11520.
1 233 -10800.
1 236 -10800.
1 50 -10080.
1 113 -10080.
1 222 -10080.
1 220 -9360.
1 223 -9360.
1 49 -8640.
1 112 -8640.
1 209 -8640.
1 207 -7920.
1 210 -7920.
```

Figure G11. Grid II, N = 20 , P-level 2 data file (Continued)

```
1 48 -7200.
1 111 -7200.
1 196 -7200.
1 194 -6480.
1 197 -6480.
1 47 -5760.
1 110 -5760.
1 183 -5760.
1 181 -5040.
1 184 -5040.
1 46 -4320.
1 109 -4320.
1 170 -4320.
1 168 -3600.
1 171 -3600.
1 45 -2880.
1 108 -2880.
1 157 -2880.
1 155 -2160.
1 158 -2160.
1 44 -1440.
1 107 -1440.
1 143 -1440.
1 140 -720.
1 145 -720.
1 43 0.
1 106 0.
1 142 0.
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
$LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
$CDATA
100 11 0 1 0 1
GRID II , N = 20
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0. 5.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
$
```

Figure G11. (Concluded)

```
B4N20II    10:41 MAY 08,'84

00100 $TOP
00110 BEAM - ASPECT RATIO = 53.33 , PLEVEL = 4
00120 1 0. 0. 0. 0
00130 21 0. 1.5 0. ,, 1 21 1.
00140 63 4. 0. 0. ,, 21 3 1.
00150 126 0. 0. 1. ,, 63 2 1.
00160 END OF COORDINATES
00170 31 1 1 22 23 2 64 85 86 65
00180 -1 2 21 20 1 0 0
00190 END OF INCIDENCES
00200 NO LOCAL COORDINATES
00210 0
00220 NO EQUIVALENTING
00230 0
00240 $SURF
00250 1
00260 10
00270 $MPLOT
00280 1
00290 101 5 1 1 1 0 2 0 0 0
00300 -80. 15. 15.
00310 END PLOT ID
00320 4
00330 1 101 0 0 0
00340 GEOMETRY PLOT      GRID II , N = 20
00350 END OF PLOT DATA
00360 $CHECK
00370 $CONST
00380 3 0 2 3
00390 4
00400 3 0 1 3
00410 3
00420 END OF CONST
00430 $PROP
00440 1
00450 ALL
00460 END OF MATERIAL DISP
00470 1 0 0
00480 4.32E9 .3
00490 15.2174 6.6E-6
00500 END OF MAT PROP
00510 $PLEVEL
00520 4
00530 ALL
00540 END OF PLEVEL DEF
00550 NO LIST
00560 $LOADS
00570 1
00580 LINEARLY VARIABLE PRESSURE
00590 4
00600 1 63 -28800.
00610 1 126 -28800.
00620 1 391 -28800.
00630 1 389 -28080.
00640 1 392 -28080.
00650 1 62 -27360.
00660 1 125 -27360.
00670 1 378 -27360.
00680 1 376 -26640.
00690 1 379 -26640.
00700 1 61 -25920.
00710 1 124 -25920.
00720 1 365 -25920.
00730 1 363 -25200.
00740 1 366 -25200.
00750 1 60 -24480.
00760 1 123 -24480.
00770 1 352 -24480.
00780 1 350 -23760.
00790 1 353 -23760.
00800 1 59 -23040.
00810 1 122 -23040.
00820 1 339 -23040.
00830 1 337 -22320.
00840 1 340 -22320.
00850 1 58 -21600.
00860 1 121 -21600.
00870 1 326 -21600.
00880 1 324 -20880.
00890 1 327 -20880.
00900 1 57 -20160.
00910 1 120 -20160.
00920 1 313 -20160.
00930 1 311 -19440.
00940 1 314 -19440.
00950 1 56 -18720.
00960 1 119 -18720.
00970 1 300 -18720.
00980 1 298 -18000.
00990 1 301 -18000.
01000 1 55 -17280.
01010 1 118 -17280.
01020 1 287 -17280.
01030 1 285 -16560.
01040 1 288 -16560.
01050 1 54 -15840.
01060 1 117 -15840.
01070 1 274 -15840.
01080 1 272 -15120.
01090 1 275 -15120.
01100 1 53 -14400.
01110 1 116 -14400.
01120 1 261 -14400.
01130 1 259 -13680.
01140 1 262 -13680.
01150 1 52 -12960.
01160 1 115 -12960.
01170 1 248 -12960.
01180 1 246 -12240.
01190 1 249 -12240.
01200 1 51 -11520.
01210 1 114 -11520.
01220 1 235 -11520.
01230 1 233 -10800.
01240 1 236 -10800.
01250 1 50 -10080.
01260 1 113 -10080.
01270 1 222 -10080.
01280 1 220 -9360.
01290 1 223 -9360.
01300 1 49 -8640.
01310 1 112 -8640.
01320 1 209 -8640.
01330 1 207 -7920.
01340 1 210 -7920.
```

Figure G12. Grid II, N = 20 , P-level 4 data file (Continued)

```
1 48 -7200.
1 111 -7200.
1 196 -7200.
1 194 -6480.
1 197 -6480.
1 47 -5760.
1 110 -5760.
1 183 -5760.
1 181 -5040.
1 184 -5040.
1 46 -4320.
1 109 -4320.
1 170 -4320.
1 168 -3600.
1 171 -3600.
1 45 -2880.
1 108 -2880.
1 157 -2880.
1 155 -2160.
1 158 -2160.
1 44 -1440.
1 107 -1440.
1 143 -1440.
1 140 -720.
1 145 -720.
1 43 0.
1 106 0.
1 142 0.
END OF PRESSURES
END OF LOAD CASE 1
END OF LOADS
$LCOMB
11
LOAD COMBINATION 1
1 1
END OF LOAD COMBINATION 1
END OF LOAD COMB DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$AXES
10 0 0
0. 0. 0. 0
END OF LOCAL AXES SYSTEM = 10
$CMESH
1
SURFACE NUMBER 1 ( Z = 0 PLANE )
2 0 1
0. 0. 5.
3
1
END OF CMESH
$CDATA
100 11 0 1 0 1
GRID II , N = 20
END OF CDATA
$CPLOT
1
200 5 0 1 1 0 1 0 0
0. 0. 5.
END PLOTID
6
19 100 200 0 0 0 0 0
PRINCIPAL STRESS1
20 100 200 0 0 0 0 0
PRINCIPAL STRESS2
END OF PLOT DATA
$ENDP
```

Figure G12. (Concluded)

```
BDN40I     12:51 MAY 08,'84

$TOP
BEAM - ASPECT RATIO = 106.67 , PLEVEL = 2
1 0. 0. 0. 0
41 0. 1.5 0. ,, 1 41 1.
82 4. 0. 0. ,, 41 2 1.
164 0. 0. 1. ,, 82 2 1.
END OF COORDINATES
31 1 1 42 43 2 83 124 125 84
-1 40 1 0 0 0 0
END OF INDIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
$SURF
1
10
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-80. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT      GRID I , N = 40
END OF PLOT DATA
$CHECK
$CONST
3 0 2 3
5
3 0 1 3
3
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.0E-6
END OF MAT PROP
$PLEVEL
2
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 82 -28800.
1 164 -28800.
1 484 -28800.
1 481 -28440.
1 486 -28440.
1 81 -28080.
1 163 -28080.
1 476 -28080.
1 473 -27720.
1 478 -27720.
1 80 -27360.
1 162 -27360.
1 468 -27360.
1 465 -27000.
1 470 -27000.
1 79 -26640.
1 161 -26640.
1 460 -26640.
1 457 -26280.
1 462 -26280.
1 78 -25920.
1 160 -25920.
1 452 -25920.
1 449 -25560.
1 454 -25560.
1 77 -25200.
1 159 -25200.
1 444 -25200.
1 441 -24840.
1 446 -24840.
1 76 -24480.
1 158 -24480.
1 436 -24480.
1 433 -24120.
1 438 -24120.
1 157 -23760.
1 75 -23760.
1 428 -23760.
1 425 -23400.
1 430 -23400.
1 74 -23040.
1 156 -23040.
1 420 -23040.
1 417 -22680.
1 422 -22680.
1 73 -22320.
1 155 -22320.
1 412 -22320.
1 409 -21960.
1 414 -21960.
1 72 -21600.
1 154 -21600.
1 404 -21600.
1 401 -21240.
1 406 -21240.
1 71 -20880.
1 153 -20880.
1 396 -20880.
1 393 -20520.
1 398 -20520.
1 70 -20160.
1 152 -20160.
1 388 -20160.
1 385 -19800.
1 390 -19800.
1 69 -19440.
1 151 -19440.
1 380 -19440.
1 377 -19080.
1 382 -19080.
1 68 -18720.
1 150 -18720.
1 372 -18720.
1 369 -18360.
1 374 -18360.
1 67 -18000.
1 149 -18000.
1 364 -18000.
1 361 -17640.
1 366 -17640.
1 66 -17280.
1 148 -17280.
1 356 -17280.
1 353 -16920.
1 358 -16920.
1 65 -16560.
1 147 -16560.
1 348 -16560.
1 345 -16200.
1 350 -16200.
1 64 -15840.
1 146 -15840.
1 340 -15840.
1 337 -15480.
1 342 -15480.
1 63 -15120.
1 145 -15120.
1 332 -15120.
1 329 -14760.
1 334 -14760.
```

Figure G13. Grid I, N = 40 , P-level 2 data file (Continued)

```
01600 1 62 -14400.
01610 1 144 -14400.
01620 1 324 -14400.
01630 1 321 -14040.
01640 1 326 -14040.
01650 1 61 -13680.
01660 1 143 -13680.
01670 1 316 -13680.
01680 1 313 -13320.
01690 1 318 -13320.
01700 1 60 -12960.
01710 1 142 -12960.
01720 1 308 -12960.
01730 1 305 -12600.
01740 1 310 -12600.
01750 1 59 -12240.
01760 1 141 -12240.
01770 1 300 -12240.
01780 1 297 -11880.
01790 1 302 -11880.
01800 1 58 -11520.
01810 1 140 -11520.
01820 1 292 -11520.
01830 1 289 -11160.
01840 1 294 -11160.
01850 1 57 -10800.
01860 1 139 -10800.
01870 1 284 -10800.
01880 1 281 -10440.
01890 1 286 -10440.
01900 1 56 -10080.
01910 1 138 -10080.
01920 1 276 -10080.
01930 1 273 -9720.
01940 1 278 -9720.
01950 1 55 -9360.
01960 1 137 -9360.
01970 1 268 -9360.
01980 1 265 -9000.
01990 1 270 -9000.
02000 1 54 -8640.
02010 1 136 -8640.
02020 1 260 -8640.
02030 1 257 -8280.
02040 1 262 -8280.
02050 1 53 -7920.
02060 1 135 -7920.
02070 1 252 -7920.
02080 1 249 -7560.
02090 1 254 -7560.
02100 1 52 -7200.
02110 1 134 -7200.
02120 1 244 -7200.
02130 1 241 -6840.
02140 1 246 -6840.
02150 1 51 -6480.
02160 1 133 -6480.
02170 1 236 -6480.
02180 1 233 -6120.
02190 1 238 -6120.
02200 1 50 -5760.
02210 1 132 -5760.
02220 1 228 -5760.
02230 1 225 -5400.
02240 1 230 -5400.
02250 1 49 -5040.
02260 1 131 -5040.
02270 1 220 -5040.
02280 1 217 -4680.
02290 1 222 -4680.
02300 1 48 -4320.
02310 1 130 -4320.
02320 1 212 -4320.
02330 1 209 -3960.
02340 1 214 -3960.
02350 1 47 -3600.
02360 1 129 -3600.
02370 1 204 -3600.
02380 1 201 -3240.
02390 1 206 -3240.
02400 1 46 -2880.
02410 1 128 -2880.
02420 1 196 -2880.
02430 1 193 -2520.
02440 1 198 -2520.
02450 1 45 -2160.
02460 1 127 -2160.
02470 1 188 -2160.
02480 1 185 -1800.
02490 1 190 -1800.
02500 1 44 -1440.
02510 1 126 -1440.
02520 1 180 -1440.
02530 1 177 -1080.
02540 1 182 -1080.
02550 1 43 -720.
02560 1 125 -720.
02570 1 171 -720.
02580 1 166 -360.
02590 1 174 -360.
02600 1 42 0.
02610 1 124 0.
02620 1 170 0.
02630 END OF PRESSURES
02640 END OF LOAD CASE 1
02650 END OF LOADS
02660 $LCOMB
02670 11
02680 LOAD COMBINATION 1
02690 1 1
02700 END OF LOAD COMBINATION 1
02710 END OF LOAD COMB DEF
02720 $LOVE
02730 $ARRAY
02740 $STIFF
02750 $STATIC
02760 $SOLVE
02770 $DISP
02780 $STRESS
02790 0
02800 ALL
02810 ALL
02820 $AXES
02830 10 0 0
02840 0. 0. 0. 0
02850 END OF LOCAL AXES SYSTEM = 10
02860 $CMESH
02870 1
02880 SURFACE NUMBER 1 ( Z = 0 PLANE )
02890 2 0 1
02900 0. 0. 5.
02910 3
02920 1
02930 END OF CMESH
02940 $CDATA
02950 100 11 0 1 0 1
02960 GRID I , N = 40
02970 END OF CDATA
02980 $CPLOT
02990 1
03000 200 5 0 1 1 0 1 0 0
03010 0. 0. 5.
03020 END PLOTID
03030 6
03040 19 100 200 0 0 0 0 0
03050 PRINCIPAL STRESS1
03060 20 100 200 0 0 0 0 0
03070 PRINCIPAL STRESS2
03080 END OF PLOT DATA
03090 $ENDP
$
```

Figure G13. (Concluded)

```
B4N40I     07.24 MAY 21,'84

00100 $TOP
00110 BEAM - ASPECT RATIO = 106.67 . PLEVEL = 4
00120 1 0  0  0. 0
00130 41 0  1 5 0  .. 1 41 1.
00140 82 4  0  0  .. 41 2 1.
00150 164 0  0  1  .. 82 2 1.
00160 END OF COORDINATES
00170 31 1 1 42 43 2 83 124 125 84
00180 -1 40 1 0 0 0 0
00190 END OF INDIDENCES
00200 NO LOCAL COORDINATES
00210 0
00220 NO EQUIVALENTING
00230 0
00240 $SURF
00250 1
00260 10
00270 $MPLOT
00280 1
00290 101 5 1 1 1 0 2 0 0 0
00300 -60  15. 15.
00310 END PLOT ID
00320 4
00330 1 101 0 0 0
00340 GEOMETRY PLOT      GRID I , N = 40
00350 END OF PLOT DATA
00360 $CHECK
00370 $CONST
00380 3 0 2 3
00390 5
00400 3 0 1 3
00410 3
00420 END OF CONST
00430 $PROP
00440 1
00450 ALL
00460 END OF MATERIAL DISP
00470 1 0 0
00480 4.32E9 .3
00490 15 2174 6.6E-6
00500 END OF MAT PROP
00510 $PLEVEL
00520 4
00530 ALL
00540 END OF PLEVEL DEF
00550 NO LIST
00560 $LOADS
00570 1
00580 LINEARLY VARIABLE PRESSURE
00590 4
00600 1 82 -28800.
00610 1 164 -28800.
00620 1 484 -28800.
00630 1 481 -28440.
00640 1 486 -28440.
00650 1 81 -28080.
00660 1 163 -28080.
00670 1 476 -28080.
00680 1 473 -27720.
00690 1 478 -27720.
00700 1 80 -27360.
00710 1 162 -27360.
00720 1 468 -27360.
00730 1 465 -27000.
00740 1 470 -27000.
00750 1 79 -26640.
00760 1 161 -26640.
00770 1 460 -26640.
00780 1 457 -26280.
00790 1 462 -26280.
00800 1 78 -25920.
00810 1 160 -25920.
00820 1 452 -25920.
00830 1 449 -25560.
00840 1 454 -25560.
00850 1 77 -25200.
00860 1 159 -25200.
00870 1 444 -25200.
00880 1 441 -24840.
00890 1 446 -24840.
00900 1 76 -24480.
00910 1 158 -24480.
00920 1 436 -24480.
00930 1 433 -24120.
00940 1 438 -24120.
00950 1 157 -23760.
00960 1 75 -23760.
00970 1 428 -23760.
00980 1 425 -23400.
00990 1 430 -23400.
01000 1 74 -23040.
01010 1 156 -23040.
01020 1 420 -23040.
01030 1 417 -22680.
01040 1 422 -22680.
01050 1 73 -22320.
01060 1 155 -22320.
01070 1 412 -22320.
01080 1 409 -21960.
01090 1 414 -21960.
01100 1 72 -21600.
01110 1 154 -21600.
01120 1 404 -21600.
01130 1 401 -21240.
01140 1 406 -21240.
01150 1 71 -20880.
01160 1 153 -20880.
01170 1 396 -20880.
01180 1 393 -20520.
01190 1 398 -20520.
01200 1 70 -20160.
01210 1 152 -20160.
01220 1 388 -20160.
01230 1 385 -19800.
01240 1 390 -19800.
01250 1 69 -19440.
01260 1 151 -19440.
01270 1 380 -19440.
01280 1 377 -19080.
01290 1 382 -19080.
01300 1 68 -18720.
01310 1 150 -18720.
01320 1 372 -18720.
01330 1 369 -18360.
01340 1 374 -18360.
01350 1 67 -18000.
01360 1 149 -18000.
01370 1 364 -18000.
01380 1 361 -17640.
01390 1 366 -17640.
01400 1 66 -17280.
01410 1 148 -17280.
01420 1 356 -17280.
01430 1 353 -16920.
01440 1 358 -16920.
01450 1 65 -16560.
01460 1 147 -16560.
01470 1 348 -16560.
01480 1 345 -16200.
01490 1 350 -16200.
01500 1 64 -15840.
01510 1 146 -15840.
01520 1 340 -15840.
01530 1 337 -15480.
01540 1 342 -15480.
01550 1 63 -15120.
01560 1 145 -15120.
01570 1 332 -15120.
01580 1 329 -14760.
01590 1 334 -14760.
```

Figure G14. Grid I, N = 40 , P-level 4 data file (Continued)

```
01600 1 62 -14400.
01610 1 144 -14400.
01620 1 324 -14400.
01630 1 321 -14040.
01640 1 326 -14040.
01650 1 61 -13680.
01660 1 143 -13680.
01670 1 316 -13680.
01680 1 313 -13320.
01690 1 318 -13320.
01700 1 60 -12960.
01710 1 142 -12960.
01720 1 308 -12960.
01730 1 305 -12600.
01740 1 310 -12600.
01750 1 59 -12240
01760 1 141 -12240.
01770 1 300 -12240.
01780 1 297 -11880.
01790 1 302 -11880.
01800 1 58 -11520.
01810 1 140 -11520.
01820 1 292 -11520.
01830 1 289 -11160.
01840 1 294 -11160.
01850 1 57 -10800.
01860 1 139 -10800.
01870 1 284 -10800.
01880 1 281 -10440.
01890 1 286 -10440.
01900 1 56 -10080.
01910 1 138 -10080.
01920 1 276 -10080.
01930 1 273 -9720.
01940 1 278 -9720.
01950 1 55 -9360
01960 1 137 -9360.
01970 1 268 -9360.
01980 1 265 -9000.
01990 1 270 -9000.
02000 1 54 -8640.
02010 1 136 -8640
02020 1 260 -8640.
02030 1 257 -8280.
02040 1 262 -8280.
02050 1 53 -7920.
02060 1 135 -7920.
02070 1 252 -7920.
02080 1 249 -7560.
02090 1 254 -7560.
02100 1 52 -7200.
02110 1 134 -7200.
02120 1 244 -7200.
02130 1 241 -6840.
02140 1 246 -6840.
02150 1 51 -6480.
02160 1 133 -6480.
02170 1 238 -6480.
02180 1 233 -6120.
02190 1 238 -6120.
02200 1 50 -5760.
02210 1 132 -5760.
02220 1 228 -5760.
02230 1 225 -5400.
02240 1 230 -5400.
02250 1 49 -5040.
02260 1 131 -5040.
02270 1 220 -5040.
02280 1 217 -4680.
02290 1 222 -4680.
02300 1 48 -4320.
02310 1 130 -4320.
02320 1 212 -4320.
02330 1 209 -3960
02340 1 214 -3960
02350 1 47 -3600.
02360 1 129 -3600.
02370 1 204 -3600.
02380 1 201 -3240.
02390 1 206 -3240.
02400 1 46 -2880.
02410 1 128 -2880.
02420 1 196 -2880.
02430 1 193 -2520.
02440 1 198 -2520.
02450 1 45 -2160.
02460 1 127 -2160.
02470 1 188 -2160.
02480 1 185 -1800.
02490 1 190 -1800.
02500 1 44 -1440.
02510 1 126 -1440.
02520 1 180 -1440.
02530 1 177 -1080.
02540 1 182 -1080.
02550 1 43 -720.
02560 1 125 -720.
02570 1 171 -720.
02580 1 166 -360.
02590 1 174 -360.
02600 1 42 0.
02610 1 124 0.
02620 1 170 0.
02630 END OF PRESSURES
02640 END OF LOAD CASE 1
02650 END OF LOADS
02660 $LCOMB
02670 11
02680 LOAD COMBINATION 1
02690 1 1
02700 END OF LOAD COMBINATION 1
02710 END OF LOAD COMB DEF
02720 $LOVE
02730 $ARRAY
02740 $STIFF
02750 $STATIC
02760 $SOLVE
02770 $DISP
02780 $STRESS
02790 0
02800 ALL
02810 ALL
02820 $AXES
02830 10 0 0
02840 0. 0. 0 0
02850 END OF LOCAL AXES SYSTEM = 10
02860 $CMESH
02870 1
02880 SURFACE NUMBER 1 ( Z = 0 PLANE )
02890 1 0 1
02900 0. 0. 5.
02910 3
02920 1
02930 END OF CMESH
02940 $CDATA
02950 100 11 0 1 0 1
02960 GRID I , N = 40
02970 END OF CDATA
02980 $CPLOT
02990 1
03000 200 5 0 1 1 0 1 0 0
03010 0. 0 5.
03020 END PLOTID
03030 6
03040 19 100 200 0 0 0 0 0
03050 PRINCIPAL STRESS1
03060 20 100 200 0 0 0 0 0
03070 PRINCIPAL STRESS2
03080 END OF PLOT DATA
03090 $ENDP
$
```

Figure G14. (Concluded)

```
B2N40II    10:01 MAY 21.'84

00100 $TOP
00110 BEAM - ASPECT RATIO = 53.33 , PLEVEL = 2
00120 1 0. 0. 0. 0
00130 41 0. 1 5 0. .. 1 41 1.
00140 123 4. 0. 0. .. 41 3 1.
00150 246 0. 0. 1. .. 123 2 1.
00160 END OF COORDINATES
00170 31 1 1 42 43 2 124 165 166 165
00180 -1 2 41 40 1 0 0
00190 END OF INCIDENCES
00200 NO LOCAL COORDINATES
00210 0
00220 NO EQUIVALENTING
00230 0
00240 $SURF
00250 1
00260 10
00270 $MPLOT
00280 1
00290 101 5 1 1 1 0 2 0 0 0
00300 -60. 15. 15.
00310 END PLOT ID
00320 4
00330 1 101 0 0 0
00340 GEOMETRY PLOT      GRID II , N = 40
00350 END OF PLOT DATA
00360 $CHECK
00370 $CONST
00380 3 0 2 3
00390 4
00400 3 0 1 3
00410 3
00420 END OF CONST
00430 $PROP
00440 1
00450 ALL
00460 END OF MATERIAL DISP
00470 1 0 0
00480 4.32E8 .3
00490 15.2174 6.0E-6
00500 END OF MAT PROP
00510 $PLEVEL
00520 2
00530 ALL
00540 END OF PLEVEL DEF
00550 NO LIST
00560 $LOADS
00570 1
00580 LINEARLY VARIABLE PRESSURE
00590 4
00600 1 123 -28800.
00610 1 246 -28800.
00620 1 771 -28800.
00630 1 769 -28440.
00640 1 772 -28440.
00650 1 122 -28080.
00660 1 245 -28080.
00670 1 758 -28080.
00680 1 756 -27720.
00690 1 759 -27720.
00700 1 121 -27360.
00710 1 244 -27360.
00720 1 745 -27360.
00730 1 743 -27000.
00740 1 746 -27000.
00750 1 120 -26640.
00760 1 243 -26640.
00770 1 732 -26640.
00780 1 730 -26280.
00790 1 733 -26280.
00800 1 119 -25920.
00810 1 242 -25920.
00820 1 719 -25920.
00830 1 717 -25560.
00840 1 720 -25560.
00850 1 118 -25200.
00860 1 241 -25200.
00870 1 706 -25200.
00880 1 704 -24840.
00890 1 707 -24840.
00900 1 117 -24480.
00910 1 240 -24480.
00920 1 693 -24480.
00930 1 691 -24120.
00940 1 694 -24120.
00950 1 116 -23760.
00960 1 239 -23760.
00970 1 680 -23760.
00980 1 678 -23400.
00990 1 681 -23400.
01000 1 115 -23040.
01010 1 238 -23040.
01020 1 667 -23040.
01030 1 665 -22680.
01040 1 668 -22680.
01050 1 114 -22320.
01060 1 237 -22320.
01070 1 654 -22320.
01080 1 652 -21960.
01090 1 655 -21960.
01100 1 113 -21600.
01110 1 236 -21600.
01120 1 641 -21600.
01130 1 639 -21240.
01140 1 642 -21240.
01150 1 112 -20880.
01160 1 235 -20880.
01170 1 628 -20880.
01180 1 626 -20520.
01190 1 629 -20520.
01200 1 111 -20160.
01210 1 234 -20160.
01220 1 615 -20160.
01230 1 613 -19800.
01240 1 616 -19800.
01250 1 110 -19440.
01260 1 233 -19440.
01270 1 602 -19440.
01280 1 600 -19080.
01290 1 603 -19080.
01300 1 109 -18720.
01310 1 232 -18720.
01320 1 589 -18720.
01330 1 587 -18360.
01340 1 590 -18360.
01350 1 108 -18000.
01360 1 231 -18000.
01370 1 576 -18000.
01380 1 574 -17640.
01390 1 577 -17640.
01400 1 107 -17280.
01410 1 230 -17280.
01420 1 563 -17280.
01430 1 561 -16920.
01440 1 564 -16920.
01450 1 106 -16560.
01460 1 229 -16560.
01470 1 550 -16560.
01480 1 548 -16200.
01490 1 551 -16200.
01500 1 105 -15840.
01510 1 228 -15840.
01520 1 537 -15840.
01530 1 535 -15480.
01540 1 538 -15480.
01550 1 104 -15120.
01560 1 227 -15120.
01570 1 524 -15120.
01580 1 522 -14760.
01590 1 525 -14760.
```

Figure G15. Grid II, N = 40 , P-level 2 data file (Continued)

```
01600 1 103 -14400.
01610 1 226 -14400.
01620 1 511 -14400.
01630 1 509 -14040.
01640 1 512 -14040.
01650 1 102 -13680.
01660 1 225 -13680.
01670 1 498 -13680.
01680 1 496 -13320.
01690 1 499 -13320.
01700 1 101 -12960.
01710 1 224 -12960.
01720 1 485 -12960.
01730 1 483 -12600.
01740 1 486 -12600.
01750 1 100 -12240.
01760 1 223 -12240.
01770 1 472 -12240.
01780 1 470 -11880.
01790 1 473 -11880.
01800 1 99 -11520.
01810 1 222 -11520.
01820 1 459 -11520.
01830 1 457 -11160.
01840 1 460 -11160.
01850 1 98 -10800.
01860 1 221 -10800.
01870 1 446 -10800.
01880 1 444 -10440.
01890 1 447 -10440.
01900 1 97 -10080.
01910 1 220 -10080.
01920 1 433 -10080.
01930 1 431 -9720.
01940 1 434 -9720.
01950 1 96 -9360.
01960 1 219 -9360.
01970 1 420 -9360.
01980 1 418 -9000.
01990 1 421 -9000.
02000 1 95 -8640.
02010 1 218 -8640.
02020 1 407 -8640.
02030 1 405 -8280.
02040 1 408 -8280.
02050 1 94 -7920.
02060 1 217 -7920.
02070 1 394 -7920.
02080 1 392 -7560.
02090 1 395 -7560.
02100 1 93 -7200.
02110 1 216 -7200.
02120 1 381 -7200.
02130 1 379 -6840.
02140 1 382 -6840.
02150 1 92 -6480.
02160 1 215 -6480.
02170 1 368 -6480.
02180 1 366 -6120.
02190 1 369 -6120.
02200 1 91 -5760.
02210 1 214 -5760.
02220 1 355 -5760.
02230 1 353 -5400.
02240 1 356 -5400.
02250 1 90 -5040.
02260 1 213 -5040.
02270 1 342 -5040.
02280 1 340 -4680.
02290 1 343 -4680.
02300 1 89 -4320.
02310 1 212 -4320.
02320 1 329 -4320.
02330 1 327 -3960.
02340 1 330 -3960.
02350 1 88 -3600.
02360 1 211 -3600.
02370 1 316 -3600.
02380 1 314 -3240.
02390 1 317 -3240.
02400 1 87 -2880.
02410 1 210 -2880.
02420 1 303 -2880.
02430 1 301 -2520.
02440 1 304 -2520.
02450 1 86 -2160.
02460 1 209 -2160.
02470 1 290 -2160.
02480 1 288 -1800.
02490 1 291 -1800.
02500 1 85 -1440.
02510 1 208 -1440.
02520 1 277 -1440.
02530 1 275 -1080.
02540 1 278 -1080.
02550 1 84 -720.
02560 1 207 -720.
02570 1 263 -720.
02580 1 260 -360.
02590 1 265 -360.
02600 1 83 0.
02610 1 206 0.
02620 1 262 0.
02630 END OF PRESSURES
02640 END OF LOAD CASE 1
02650 END OF LOADS
02660 $LCOMB
02670 11
02680 LOAD COMBINATION 1
02690 1 1
02700 END OF LOAD COMBINATION 1
02710 END OF LOAD COMB DEF
02720 $LOVE
02730 $ARRAY
02740 $STIFF
02750 $STATIC
02760 $SOLVE
02770 $DISP
02780 $STRESS
02790 0
02800 ALL
02810 ALL
02820 $AXES
02830 10 0 0
02840 0. 0. 0. 0
02850 END OF LOCAL AXES SYSTEM = 10
02860 $CMESH
02870 1
02880 SURFACE NUMBER 1 ( Z = 0 PLANE )
02890 1 0 1
02900 0. 0. 5.
02910 3
02920 1
02930 END OF CMESH
02940 $CDATA
02950 100 11 0 1 0 1
02960 GRID 11 , N = 40
02970 END OF CDATA
02980 $CPLOT
02990 1
03000 200 5 0 1 1 0 1 0 0
03010 0. 0. 5.
03020 END PLOTID
03030 6
03040 19 100 200 0 0 0 0 0
03050 PRINCIPAL STRESS1
03060 20 100 200 0 0 0 0 0
03070 PRINCIPAL STRESS2
03080 END OF PLOT DATA
03090 $ENDP
$
```

Figure G15. (Concluded)

```
B4N40II    10:04 MAY 21.'84

$TOP
BEAM - ASPECT RATIO = 53.33 . PLEVEL = 4
1 0. 0. 0. 0
41 0. 1.5 0. .. 1 41 1.
123 4  0  0. .. 41 3 1.
246 0. 0. 1. .. 123 2 1.
END OF COORDINATES
31 1 1 42 43 2 124 165 166 125
-1 2 41 40 1 0 0
END OF INCIDENCES
NO LOCAL COORDINATES
0
NO EQUIVALENTING
0
$SURF
1
10
$MPLOT
1
101 5 1 1 1 0 2 0 0 0
-60. 15. 15.
END PLOT ID
4
1 101 0 0 0
GEOMETRY PLOT        GRID II , N = 40
END OF PLOT DATA
$CHECK
$CONST
3 0 2 3
4
3 0 1 3
3
END OF CONST
$PROP
1
ALL
END OF MATERIAL DISP
1 0 0
4.32E9 .3
15.2174 6.0E-6
END OF MAT PROP
$PLEVEL
4
ALL
END OF PLEVEL DEF
NO LIST
$LOADS
1
LINEARLY VARIABLE PRESSURE
4
1 123 -28800.
1 246 -28800.
1 771 -28800.
1 769 -28440.
1 772 -28440.
1 122 -28080.
1 245 -28080.
1 758 -28080.
1 756 -27720.
1 759 -27720.
1 121 -27360.
1 244 -27360.
1 745 -27360.
1 743 -27000.
1 746 -27000.
1 120 -26640.
1 243 -26640.
1 732 -26640.
1 730 -26280.
1 733 -26280.
1 119 -25920.
1 242 -25920.
1 719 -25920.
1 717 -25560.
1 720 -25560.
1 118 -25200.
1 241 -25200.
1 706 -25200.
1 704 -24840.
1 707 -24840.
1 117 -24480.
1 240 -24480.
1 693 -24480.
1 691 -24120.
1 694 -24120.
1 116 -23760.
1 239 -23760.
1 680 -23760.
1 678 -23400.
1 681 -23400.
1 115 -23040.
1 238 -23040.
1 667 -23040.
1 665 -22680.
1 668 -22680.
1 114 -22320.
1 237 -22320.
1 654 -22320.
1 652 -21960.
1 655 -21960.
1 113 -21600.
1 236 -21600.
1 641 -21600.
1 639 -21240.
1 642 -21240.
1 112 -20880.
1 235 -20880.
1 628 -20880.
1 626 -20520.
1 629 -20520.
1 111 -20160.
1 234 -20160.
1 615 -20160.
1 613 -19800.
1 616 -19800.
1 110 -19440.
1 233 -19440.
1 602 -19440.
1 600 -19080.
1 603 -19080.
1 109 -18720.
1 232 -18720.
1 589 -18720.
1 587 -18360.
1 590 -18360.
1 108 -18000.
1 231 -18000.
1 576 -18000.
1 574 -17640.
1 577 -17640.
1 107 -17280.
1 230 -17280.
1 563 -17280.
1 561 -16920.
1 564 -16920.
1 106 -16560.
1 229 -16560.
1 550 -16560.
1 548 -16200.
1 551 -16200.
1 105 -15840.
1 228 -15840.
1 537 -15840.
1 535 -15480.
1 538 -15480.
1 104 -15120.
1 227 -15120.
1 524 -15120.
1 522 -14760.
1 525 -14760.
1 103 -14400.
```

Figure G16. Grid II, N = 40 , P-level 4 data file (Continued)

```
01610 1 506 -14400.
01620 1 511 -14400.
01630 1 509 -14040.
01640 1 512 -14040.
01650 1 102 -13680.
01660 1 505 -13680.
01670 1 498 -13680.
01680 1 496 -13320.
01690 1 499 -13320.
01700 1 101 -12960.
01710 1 504 -12960.
01720 1 485 -12960.
01730 1 483 -12600.
01740 1 486 -12600.
01750 1 100 -12240.
01760 1 503 -12240.
01770 1 472 -12240.
01780 1 470 -11880.
01790 1 473 -11880.
01800 1 99 -11520.
01810 1 502 -11520.
01820 1 459 -11520.
01830 1 457 -11160.
01840 1 460 -11160.
01850 1 98 -10800.
01860 1 501 -10800.
01870 1 446 -10800.
01880 1 444 -10440.
01890 1 447 -10440.
01900 1 97 -10080.
01910 1 500 -10080.
01920 1 433 -10080.
01930 1 431 -9720.
01940 1 434 -9720.
01950 1 96 -9360.
01960 1 519 -9360.
01970 1 420 -9360.
01980 1 418 -9000.
01990 1 421 -9000.
02000 1 95 -8640.
02010 1 518 -8640.
02020 1 407 -8640.
02030 1 405 -8280.
02040 1 408 -8280.
02050 1 94 -7920.
02060 1 517 -7920.
02070 1 394 -7920.
02080 1 392 -7560.
02090 1 395 -7560.
02100 1 93 -7200.
02110 1 516 -7200.
02120 1 381 -7200.
02130 1 379 -6840.
02140 1 382 -6840.
02150 1 92 -6480.
02160 1 515 -6480.
02170 1 368 -6480.
02180 1 366 -6120.
02190 1 369 -6120.
02200 1 91 -5760.
02210 1 514 -5760.
02220 1 355 -5760.
02230 1 353 -5400.
02240 1 356 -5400.
02250 1 90 -5040.
02260 1 513 -5040.
02270 1 342 -5040.
02280 1 340 -4680.
02290 1 343 -4680.
02300 1 89 -4320.
02310 1 512 -4320.
02320 1 329 -4320.
02330 1 327 -3960.
02340 1 330 -3960.
02350 1 88 -3600.
02360 1 511 -3600.
02370 1 316 -3600.
02380 1 314 -3240.
02390 1 317 -3240.
02400 1 87 -2880.
02410 1 510 -2880.
02420 1 303 -2880.
02430 1 301 -2520.
02440 1 304 -2520.
02450 1 86 -2160.
02460 1 509 -2160.
02470 1 290 -2160.
02480 1 288 -1800.
02490 1 291 -1800.
02500 1 85 -1440.
02510 1 508 -1440.
02520 1 277 -1440.
02530 1 275 -1080.
02540 1 278 -1080.
02550 1 84 -720.
02560 1 507 -720.
02570 1 263 -720.
02580 1 266 -360.
02590 1 265 -360.
02600 1 83 0.
02610 1 506 0.
02620 1 262 0
02630 END OF PRESSURES
02640 END OF LOAD CASE 1
02650 END OF LOADS
02660 $LCOMB
02670 11
02680 LOAD COMBINATION 1
02690 1 1
02700 END OF LOAD COMBINATION 1
02710 END OF LOAD COMB DEF
02720 $LOVE
02730 $ARRAY
02740 $STIFF
02750 $STATIC
02760 $SOLVE
02770 $DISP
02780 $STRESS
02790 0
02800 ALL
02810 ALL
02820 $AXES
02830 10 0 0
02840 0. 0. 0. 0
02850 END OF LOCAL AXES SYSTEM = 10
02860 $CMESH
02870 1
02880 SURFACE NUMBER 1 ( Z = 0 PLANE )
02890 1 0 1
02900 0. 0. 5.
02910 3
02920 1
02930 END OF CMESH
02940 $CDATA
02950 100 11 0 1 0 1
02960 GRID II , N = 40
02970 END OF CDATA
02980 $CPLOT
02990 1
03000 200 5 0 1 1 0 1 0 0
03010 0. 0. 5.
03020 END PLOTID
03030 6
03040 10 100 200 0 0 0 0 0
03050 PRINCIPAL STRESS1
03060 20 100 200 0 0 0 0 0
03070 PRINCIPAL STRESS2
03080 END OF PLOT DATA
03090 $ENDP
0
```

Figure G16. (Concluded)

```
BENDOII    10.07 MAY 31.'84

00100 $TOP
00110 BEAM - ASPECT RATIO = 106.66 . PLEVEL = 2
00120 1 0. 0. 0. 0
00130 81 0. 1.5 0. .. 1 81 1.
00140 243 4. 0. 0. .. 81 3 1.
00150 486 0. 0. 1. .. 243 2 1.
00160 END OF COORDINATES
00170 81 1 1 82 83 2 244 325 326 245
00180 -1 2 81 80 1 0 0
00190 END OF INCIDENCES
00200 NO LOCAL COORDINATES
00210 0
00220 NO EQUIVALENTING
00230 0
00240 $SURF
00250 1
00260 10
00270 $NPLOT
00280 1
00290 101 5 1 1 1 0 2 0 0 0
00300 -60. 15. 15.
00310 END PLOT ID
00320 4
00330 1 101 0 0 0
00340 GEOMETRY PLOT      GRID II . N = 80
00350 END OF PLOT DATA
00360 $CHECK
00370 $CONST
00380 3 0 2 3
00390 4
00400 3 0 1 3
00410 3
00420 END OF CONST
00430 $PROP
00440 1
00450 ALL
00460 END OF MATERIAL DISP
00470 1 0 0
00480 4.32E3 .3
00490 15.2174 6.6E-6
00500 END OF MAT PROP
00510 $PLEVEL
00520 2
00530 ALL
00540 END OF PLEVEL DEF
00550 NO LIST
00560 $LOADS
00570 1
00580 LINEARLY VARIABLE PRESSURE
00590 4
00600 1 843 -28800.
00610 1 1531 -28800.
00620 1 486 -28800.
00630 1 1529 -28620.
00640 1 1532 -28620.
00650 1 842 -28440.
00660 1 1518 -28440.
00670 1 485 -28440.
00680 1 1516 -28260.
00690 1 1519 -28260.
00700 1 841 -28080.
00710 1 1505 -28080.
00720 1 484 -28080.
00730 1 1503 -27900.
00740 1 1506 -27900.
00750 1 840 -27720.
00760 1 1492 -27720.
00770 1 483 -27720.
00780 1 1490 -27540.
00790 1 1493 -27540.
00800 1 839 -27360.
00810 1 1479 -27360.
00820 1 482 -27360.
00830 1 1477 -27180.
00840 1 1480 -27180.
00850 1 838 -27000.
00860 1 1466 -27000.
00870 1 481 -27000.
00880 1 1464 -26820.
00890 1 1467 -26820.
00900 1 837 -26640.
00910 1 1463 -26640.
00920 1 480 -26640.
00930 1 1451 -26460.
00940 1 1454 -26460.
00950 1 236 -26280.
00960 1 1440 -26280.
00970 1 479 -26280.
00980 1 1438 -26100.
00990 1 1441 -26100.
01000 1 235 -25920.
01010 1 1427 -25920.
01020 1 478 -25920.
01030 1 1425 -25740.
01040 1 1428 -25740.
01050 1 234 -25560.
01060 1 1414 -25560.
01070 1 477 -25560.
01080 1 1412 -25380.
01090 1 1415 -25380.
01100 1 233 -25200.
01110 1 1401 -25200.
01120 1 476 -25200.
01130 1 1399 -25020.
01140 1 1402 -25020.
01150 1 232 -24840.
01160 1 1388 -24840.
01170 1 475 -24840.
01180 1 1386 -24660.
01190 1 1389 -24660.
01200 1 231 -24480.
01210 1 1375 -24480.
01220 1 474 -24480.
01230 1 1373 -24300.
01240 1 1376 -24300.
01250 1 230 -24120.
01260 1 1362 -24120.
01270 1 473 -24120.
01280 1 1360 -23940.
01290 1 1363 -23940.
01300 1 229 -23760.
01310 1 1349 -23760.
01320 1 472 -23760.
01330 1 1347 -23580.
01340 1 1350 -23580.
01350 1 228 -23400
01360 1 1336 -23400.
01370 1 471 -23400
01380 1 1334 -23220.
01390 1 1337 -23220.
01400 1 227 -23040.
01410 1 1323 -23040.
01420 1 470 -23040.
01430 1 1321 -22860.
01440 1 1324 -22860.
01450 1 226 -22680.
01460 1 1310 -22680.
01470 1 469 -22680.
01480 1 1308 -22500.
01490 1 1311 -22500.
01500 1 225 -22320.
01510 1 1297 -22320.
01520 1 468 -22320.
01530 1 1295 -22140.
01540 1 1298 -22140.
01550 1 224 -21960.
01560 1 1284 -21960.
01570 1 467 -21960.
01580 1 1282 -21780.
01590 1 1285 -21780.
01600 1 223 -21600.
01610 1 1271 -21600.
01620 1 466 -21600.
01630 1 1269 -21420.
01640 1 1272 -21420.
01650 1 222 -21240.
01660 1 1258 -21240.
01670 1 465 -21240.
01680 1 1256 -21060.
01690 1 1259 -21060.
01700 1 221 -20880.
01710 1 1245 -20880.
01720 1 464 -20880.
01730 1 1243 -20700.
01740 1 1246 -20700.
01750 1 220 -20520.
```

Figure G17. Grid II, N = 80 , P-level 2 data file (Sheet 1 of 3)

01760	1	1232	-20520.
01770	1	463	-20520.
01780	1	1230	-20340.
01790	1	1233	-20340.
01800	1	219	-20160.
01810	1	1219	-20160.
01820	1	462	-20160.
01830	1	1217	-19980.
01840	1	1220	-19980.
01850	1	218	-19800.
01860	1	1206	-19800.
01870	1	461	-19800.
01880	1	1204	-19620.
01890	1	1207	-19620.
01900	1	217	-19440.
01910	1	1193	-19440.
01920	1	460	-19440.
01930	1	1191	-19260.
01940	1	1194	-19260.
01950	1	216	-19080.
01960	1	1180	-19080.
01970	1	459	-19080.
01980	1	1178	-18900.
01990	1	1181	-18900.
02000	1	215	-18720.
02010	1	1167	-18720.
02020	1	458	-18720.
02030	1	1165	-18540.
02040	1	1168	-18540.
02050	1	214	-18360.
02060	1	1154	-18360.
02070	1	457	-18360.
02080	1	1152	-18180.
02090	1	1155	-18180.
02100	1	213	-18000.
02110	1	1141	-18000.
02120	1	456	-18000.
02130	1	1139	-17820.
02140	1	1142	-17820.
02150	1	212	-17640.
02160	1	1128	-17640.
02170	1	455	-17640.
02180	1	1126	-17460.
02190	1	1129	-17460.
02200	1	211	-17280.
02210	1	1115	-17280.
02220	1	464	-17280.
02230	1	1113	-17100.
02240	1	1116	-17100.
02250	1	210	-16920.
02260	1	1102	-16920.
02270	1	453	-16920.
02280	1	1100	-16740.
02290	1	1103	-16740.
02300	1	209	-16560.
02310	1	1089	-16560.
02320	1	452	-16560.
02330	1	1087	-16380.
02340	1	1090	-16380.
02350	1	208	-16200.
02360	1	1076	-16200.
02370	1	451	-16200.
02380	1	1074	-16020.
02390	1	1077	-16020.
02400	1	207	-15840.
02410	1	1063	-15840.
02420	1	450	-15840.
02430	1	1061	-15660.
02440	1	1064	-15660.
02450	1	206	-15480.
02460	1	1050	-15480.
02470	1	449	-15480.
02480	1	1048	-15300.
02490	1	1051	-15300.
02500	1	205	-15120.
02510	1	1037	-15120.
02520	1	448	-15120.
02530	1	1035	-14940.
02540	1	1038	-14940.
02550	1	204	-14760.
02560	1	1024	-14760.
02570	1	447	-14760.
02580	1	1022	-14580.
02590	1	1025	-14580.

02600	1	203	-14400.
02610	1	1011	-14400.
02620	1	446	-14400.
02630	1	1009	-14220
02640	1	1012	-14220.
02650	1	202	-14040.
02660	1	998	-14040.
02670	1	445	-14040.
02680	1	996	-13860.
02690	1	999	-13860.
02700	1	201	-13680.
02710	1	985	-13680.
02720	1	444	-13680.
02730	1	983	-13500.
02740	1	986	-13500.
02750	1	200	-13320.
02760	1	972	-13320.
02770	1	443	-13320.
02780	1	970	-13140.
02790	1	973	-13140.
02800	1	199	-12960.
02810	1	959	-12960.
02820	1	442	-12960.
02830	1	957	-12780.
02840	1	960	-12780.
02850	1	198	-12600.
02860	1	946	-12600.
02870	1	441	-12600.
02880	1	944	-12420.
02890	1	947	-12420.
02900	1	197	-12240.
02910	1	933	-12240.
02920	1	440	-12240.
02930	1	931	-12060.
02940	1	934	-12060.
02950	1	196	-11880.
02960	1	920	-11880.
02970	1	439	-11880.
02980	1	918	-11700.
02990	1	921	-11700.
03000	1	195	-11520.
03010	1	907	-11520.
03020	1	438	-11520.
03030	1	905	-11340.
03040	1	908	-11340.
03050	1	194	-11160.
03060	1	894	-11160.
03070	1	437	-11160.
03080	1	892	-10980.
03090	1	895	-10980.
03100	1	193	-10800.
03110	1	881	-10800.
03120	1	436	-10800.
03130	1	879	-10620.
03140	1	882	-10620.
03150	1	192	-10440.
03160	1	868	-10440.
03170	1	435	-10440.
03180	1	866	-10260.
03190	1	869	-10260.
03200	1	191	-10080.
03210	1	855	-10080.
03220	1	434	-10080.
03230	1	853	-9900.
03240	1	856	-9900.
03250	1	190	-9720.
03260	1	842	-9720.
03270	1	433	-9720.
03280	1	840	-9540.
03290	1	843	-9540.
03300	1	189	-9360.
03310	1	829	-9360.
03320	1	432	-9360.
03330	1	827	-9180.
03340	1	830	-9180.
03350	1	188	-9000.
03360	1	816	-9000.
03370	1	431	-9000.
03380	1	814	-8820.
03390	1	817	-8820.
03400	1	187	-8640.
03410	1	803	-8640.
03420	1	430	-8640.
03430	1	801	-8460.

Figure G17. (Sheet 2 of 3)

```
03440 1 804 -8460.
03450 1 186 -8280.
03460 1 790 -8280.
03470 1 429 -8280.
03480 1 788 -8100.
03490 1 791 -8100.
03500 1 185 -7920.
03510 1 777 -7920.
03520 1 428 -7920.
03530 1 775 -7740.
03540 1 778 -7740.
03550 1 184 -7560.
03560 1 764 -7560.
03570 1 427 -7560.
03580 1 762 -7380.
03590 1 765 -7380.
03600 1 183 -7200.
03610 1 751 -7200.
03620 1 426 -7200.
03630 1 749 -7020.
03640 1 752 -7020.
03650 1 182 -6840.
03660 1 738 -6840.
03670 1 425 -6840.
03680 1 736 -6660.
03690 1 739 -6660.
03700 1 181 -6480.
03710 1 725 -6480.
03720 1 424 -6480.
03730 1 723 -6300.
03740 1 726 -6300.
03750 1 180 -6120.
03760 1 712 -6120.
03770 1 423 -6120.
03780 1 710 -5940.
03790 1 713 -5940.
03800 1 179 -5760.
03810 1 699 -5760.
03820 1 422 -5760.
03830 1 697 -5580.
03840 1 700 -5580.
03850 1 178 -5400.
03860 1 686 -5400.
03870 1 421 -5400.
03880 1 684 -5220.
03890 1 687 -5220.
03900 1 177 -5040.
03910 1 673 -5040.
03920 1 420 -5040.
03930 1 671 -4860.
03940 1 674 -4860.
03950 1 176 -4680.
03960 1 660 -4680.
03970 1 419 -4680.
03980 1 658 -4500.
03990 1 661 -4500.
04000 1 175 -4320.
04010 1 647 -4320.
04020 1 418 -4320.
04030 1 645 -4140.
04040 1 648 -4140.
04050 1 174 -3960.
04060 1 634 -3960.
04070 1 417 -3960.
04080 1 632 -3780.
04090 1 635 -3780.
04100 1 173 -3600.
04110 1 621 -3600.
04120 1 416 -3600.
04130 1 619 -3420.
04140 1 622 -3420.
04150 1 172 -3240.
04160 1 608 -3240.
04170 1 415 -3240.
04180 1 606 -3060.
04190 1 609 -3060.
04200 1 171 -2880.
04210 1 595 -2880.
04220 1 414 -2880.
04230 1 593 -2700.
04240 1 596 -2700.
04250 1 170 -2520.
04260 1 582 -2520.
04270 1 413 -2520.
04280 1 580 -2340.
04290 1 583 -2340.
04300 1 169 -2160.
04310 1 569 -2160.
04320 1 412 -2160.
04330 1 567 -1980.
04340 1 570 -1980.
04350 1 168 -1800.
04360 1 556 -1800.
04370 1 411 -1800.
04380 1 554 -1620.
04390 1 557 -1620.
04400 1 167 -1440.
04410 1 543 -1440.
04420 1 410 -1440.
04430 1 541 -1260.
04440 1 544 -1260.
04450 1 166 -1080.
04460 1 530 -1080.
04470 1 409 -1080.
04480 1 528 -900.
04490 1 531 -900.
04500 1 165 -720.
04510 1 517 -720.
04520 1 408 -720.
04530 1 515 -540.
04540 1 518 -540.
04550 1 164 -360.
04560 1 503 -360.
04570 1 407 -360.
04580 1 500 -180.
04590 1 506 -180.
04600 1 163 0.
04610 1 502 0.
04620 1 406 0.
04630 END OF PRESSURES
04640 END OF LOAD CASE 1
04650 END OF LOADS
04660 $LCOMB
04670 11
04680 LOAD COMBINATION 1
04690 1 1
04700 END OF LOAD COMBINATION 1
04710 END OF LOAD COMB DEF
04720 $LOVE
04730 $ARRAY
04740 $STIFF
04750 $STATIC
04760 $SOLVE
04770 $DISP
04780 $STRESS
04790 0
04800 ALL
04810 ALL
04820 $AXES
04830 10 0 0
04840 0. 0. 0. 0
04850 END OF LOCAL AXES SYSTEM = 10
04860 $CMESH
04870 1
04880 SURFACE NUMBER 1 ( Z = 0 PLANE )
04890 1 0 1
04900 0. 0. 5.
04910 3
04920 1
04930 END OF CMESH
04940 $CDATA
04950 100 11 0 1 0 1
04960 GRID II , M = 80
04970 END OF CDATA
04980 $CPLOT
04990 1
05000 200 5 0 1 1 0 1 0 0
05010 0. 0. 5.
05020 END PLOTID
05030 6
05040 10 100 200 0 0 0 0 0
05050 PRINCIPAL STRESS1
05060 20 100 200 0 0 0 0 0
05070 PRINCIPAL STRESS2
05080 END OF PLOT DATA
05090 $ENDP
0
```

Figure G17. (Sheet 3 of 3)

```
B4N80II    10:13 MAY 21.'84

00100 $TOP
00110 BEAM - ASPECT RATIO = 106.66 , PLEVEL = 4
00120 1 0 0. 0. 0
00130 81 0. 1.5 0. .. 1 81 1.
00140 243 4. 0. 0. .. 81 3 1.
00150 486 0. 0. 1. .. 243 2 1.
00160 END OF COORDINATES
00170 31 1 1 82 83 2 244 325 326 245
00180 -1 2 81 80 1 0 0
00190 END OF INCIDENCES
00200 NO LOCAL COORDINATES
00210 0
00220 NO EQUIVALENTING
00230 0
00240 $SURF
00250 1
00260 10
00270 $MPLOT
00280 1
00290 101 5 1 1 1 0 2 0 0 0
00300 -60. 15. 15.
00310 END PLOT ID
00320 4
00330 1 101 0 0 0
00340 GEOMETRY PLOT      GRID II , N = 80
00350 END OF PLOT DATA
00360 $CHECK
00370 $CONST
00380 3 0 2 3
00390 4
00400 3 0 1 3
00410 3
00420 END OF CONST
00430 $PROP
00440 1
00450 ALL
00460 END OF MATERIAL DISP
00470 1 0 0
00480 4.32E9 .3
00490 15.2174 6.0E-6
00500 END OF MAT PROP
00510 $PLEVEL
00520 4
00530 ALL
00540 END OF PLEVEL DEF
00550 NO LIST
00560 $LOADS
00570 1
00580 LINEARLY VARIABLE PRESSURE
00590 4
00600 1 243 -28800.
00610 1 1531 -28800.
00620 1 486 -28800.
00630 1 1529 -28620.
00640 1 1532 -28620.
00650 1 242 -28440.
00660 1 1518 -28440.
00670 1 485 -28440.
00680 1 1516 -28260.
00690 1 1519 -28260.
00700 1 241 -28080.
00710 1 1505 -28080.
00720 1 484 -28080.
00730 1 1503 -27900.
00740 1 1506 -27900.
00750 1 240 -27720.
00760 1 1492 -27720.
00770 1 483 -27720.
00780 1 1490 -27540.
00790 1 1493 -27540.
00800 1 239 -27360.
00810 1 1479 -27360.
00820 1 482 -27360.
00830 1 1477 -27180.
00840 1 1480 -27180.
00850 1 238 -27000.
00860 1 1466 -27000.
00870 1 481 -27000.
00880 1 1464 -26820.
00890 1 1467 -26820.
00900 1 237 -26640.
00910 1 1453 -26640.
00920 1 480 -26640.
00930 1 1451 -26460.
00940 1 1454 -26460.
00950 1 236 -26280.
00960 1 1440 -26280.
00970 1 479 -26280.
00980 1 1438 -26100.
00990 1 1441 -26100.
01000 1 235 -25920.
01010 1 1427 -25920.
01020 1 478 -25920.
01030 1 1425 -25740.
01040 1 1428 -25740.
01050 1 234 -25560.
01060 1 1414 -25560.
01070 1 477 -25560.
01080 1 1412 -25380.
01090 1 1415 -25380.
01100 1 233 -25200.
01110 1 1401 -25200.
01120 1 476 -25200.
01130 1 1399 -25020.
01140 1 1402 -25020.
01150 1 232 -24840.
01160 1 1388 -24840.
01170 1 475 -24840.
01180 1 1386 -24660.
01190 1 1389 -24660.
01200 1 231 -24480.
01210 1 1375 -24480.
01220 1 474 -24480.
01230 1 1373 -24300.
01240 1 1376 -24300.
01250 1 230 -24120.
01260 1 1362 -24120.
01270 1 473 -24120.
01280 1 1360 -23940.
01290 1 1363 -23940.
01300 1 229 -23760.
01310 1 1349 -23760.
01320 1 472 -23760.
01330 1 1347 -23580.
01340 1 1350 -23580.
01350 1 228 -23400
01360 1 1336 -23400
01370 1 471 -23400.
01380 1 1334 -23220.
01390 1 1337 -23220
01400 1 227 -23040
01410 1 1323 -23040
01420 1 470 -23040
01430 1 1321 -22860
01440 1 1324 -22860.
01450 1 226 -22680.
01460 1 1310 -22680
01470 1 469 -22680
01480 1 1308 -22500
01490 1 1311 -22500
01500 1 225 -22320
01510 1 1297 -22320
01520 1 468 -22320
01530 1 1295 -22140
01540 1 1298 -22140
01550 1 224 -21960
01560 1 1284 -21960
01570 1 467 -21960
01580 1 1282 -21780
01590 1 1285 -21780
01600 1 223 -21600.
01610 1 1271 -21600
01620 1 466 -21600
01630 1 1269 -21420
01640 1 1272 -21420
01650 1 222 -21240
01660 1 1258 -21240
01670 1 465 -21240.
01680 1 1256 -21060
01690 1 1259 -21060
01700 1 221 -20880
01710 1 1245 -20880
01720 1 464 -20880
01730 1 1243 -20700
01740 1 1246 -20700
01750 1 220 -20520
01760 1 1232 -20520
01770 1 463 -20520
```

Figure G18. Grid II, N = 80 , P-level 4 data file (Sheet 1 of 3)

```
01780 1 1230 -20340.
01790 1 1233 -20340.
01800 1 219 -20160.
01810 1 1219 -20160.
01820 1 462 -20160.
01830 1 1217 -19980.
01840 1 1220 -19980.
01850 1 218 -19800.
01860 1 1206 -19800.
01870 1 461 -19800.
01880 1 1204 -19620.
01890 1 1207 -19620.
01900 1 217 -19440.
01910 1 1193 -19440.
01920 1 460 -19440.
01930 1 1191 -19260.
01940 1 1194 -19260.
01950 1 216 -19080.
01960 1 1180 -19080.
01970 1 459 -19080.
01980 1 1178 -18900.
01990 1 1181 -18900.
02000 1 215 -18720.
02010 1 1167 -18720
02020 1 458 -18720.
02030 1 1165 -18540
02040 1 1168 -18540
02050 1 214 -18360.
02060 1 1154 -18360.
02070 1 457 -18360.
02080 1 1152 -18180.
02090 1 1155 -18180.
02100 1 213 -18000.
02110 1 1141 -18000.
02120 1 456 -18000.
02130 1 1139 -17820.
02140 1 1142 -17820.
02150 1 212 -17640.
02160 1 1128 -17640.
02170 1 455 -17640.
02180 1 1126 -17460.
02190 1 1129 -17460.
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02260 1 1102 -16920.
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02580 1 1022 -14580.
02590 1 1025 -14580.
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02610 1 1011 -14400.
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Figure G18. (Sheet 2 of 3)

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04650 END OF LOADS
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04670 11
04680 LOAD COMBINATION 1
04690 1 1
04700 END OF LOAD COMBINATION 1
04710 END OF LOAD COMB DEF
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04730 $ARRAY
04740 $STIFF
04750 $STATIC
04760 $SOLVE
04770 $DISP
04780 $STRESS
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04810 ALL
04820 $AXES
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04860 $CMESH
04870 1
04880 SURFACE NUMBER 1 ( Z = 0 PLANE )
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04910 3
04920 1
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04940 $CDATA
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04970 END OF CDATA
04980 $CPLOT
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05010 0. 0. 5.
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Figure G18. (Sheet 3 of 3)

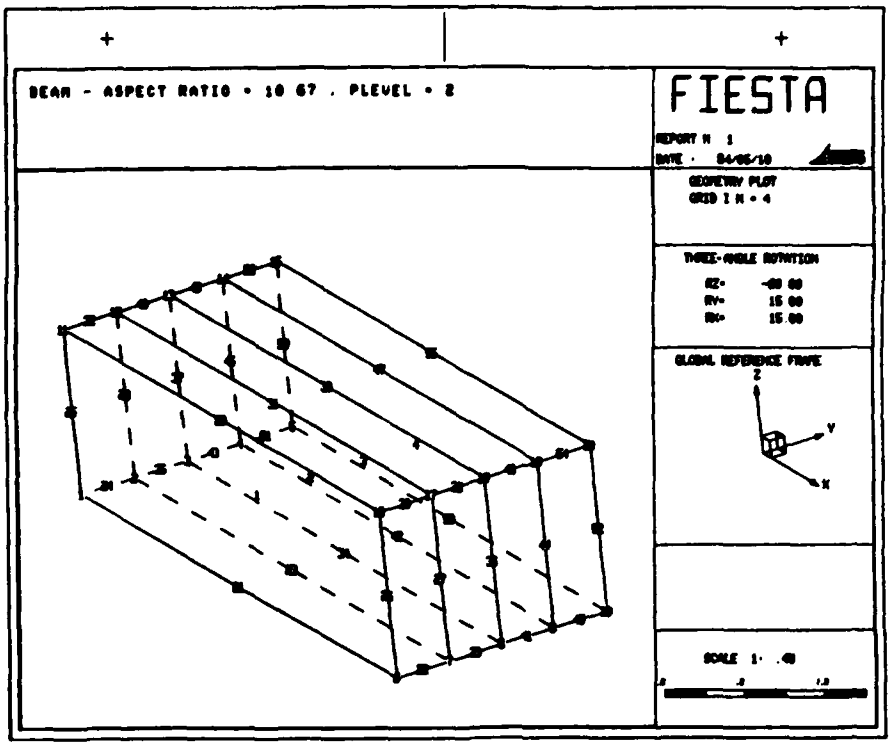

Figure G19. Annotated geometry plot
grid I, N = 4 , P-level 2

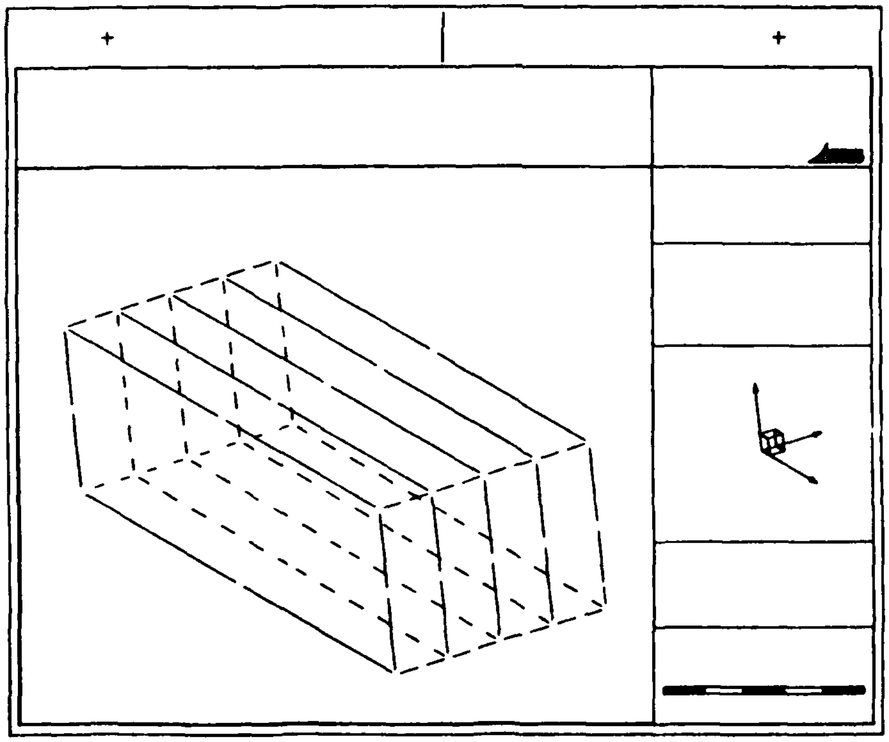

Figure G20. Nonannotated geometry plot
grid I, N = 4 , P-level 2

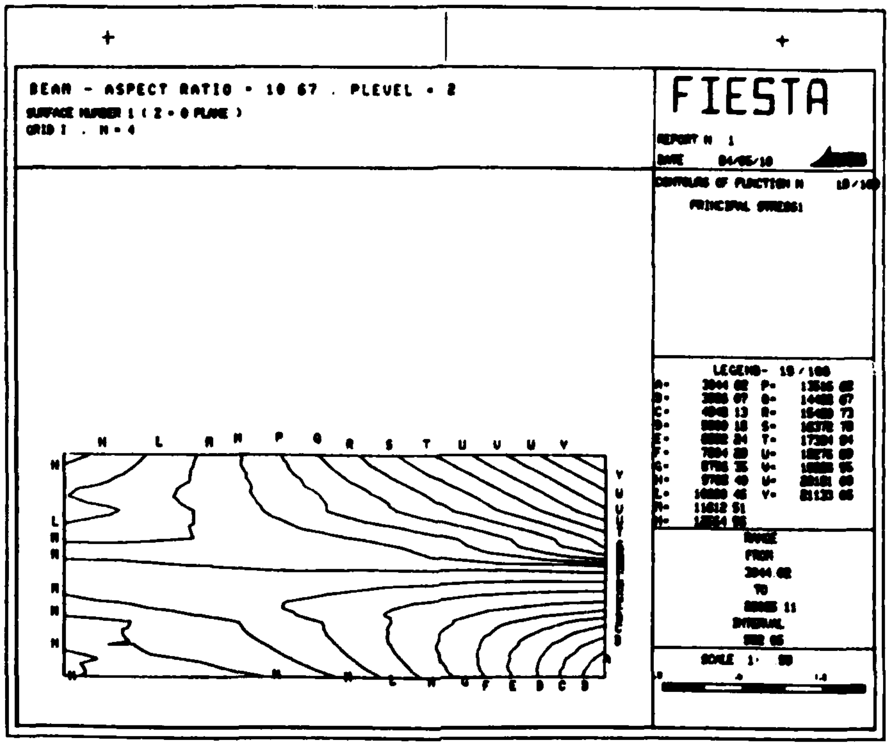

Figure G21. Annotated, X-direction principal stress contours grid I, N = 4 , P-level 2

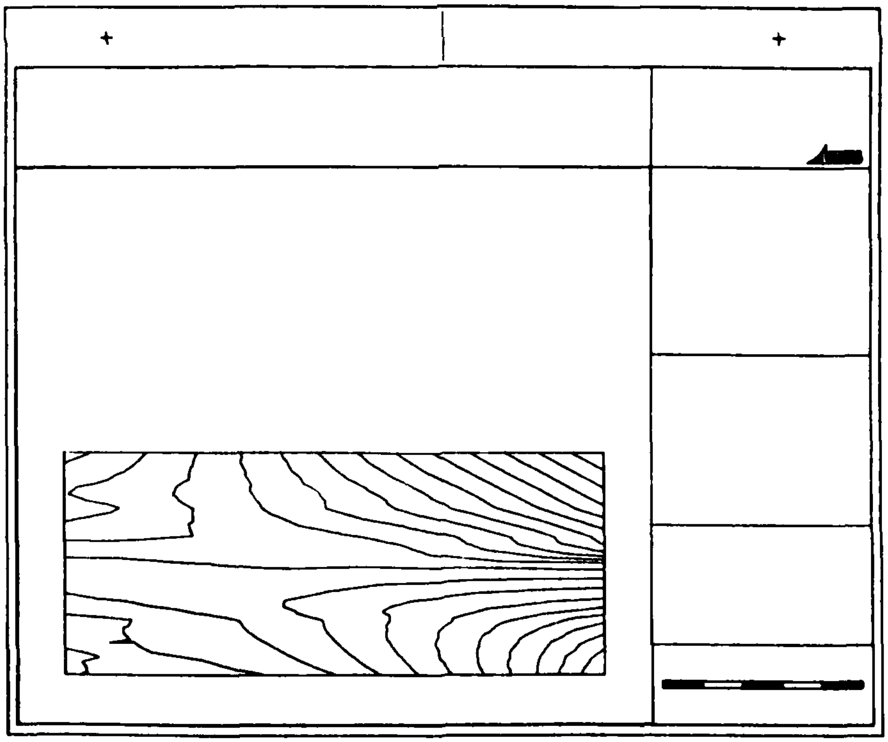

Figure G22. Nonannotated, X-direction principal stress contours grid I, N = 4 , P-level 2

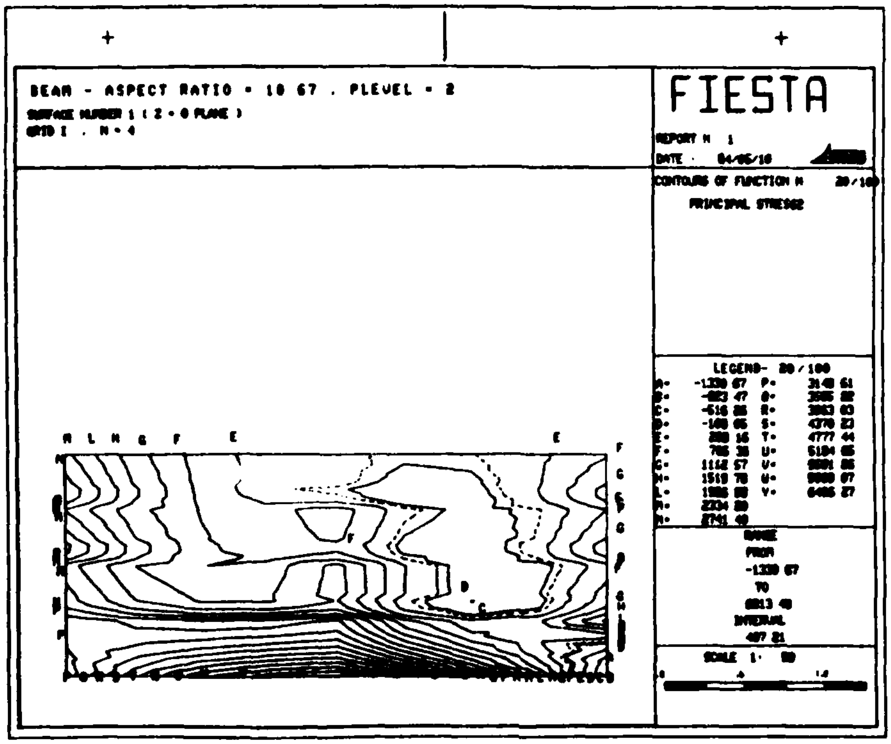

Figure G23. Annotated, Y-direction principal stress contours grid I, N = 4 , P-level 2

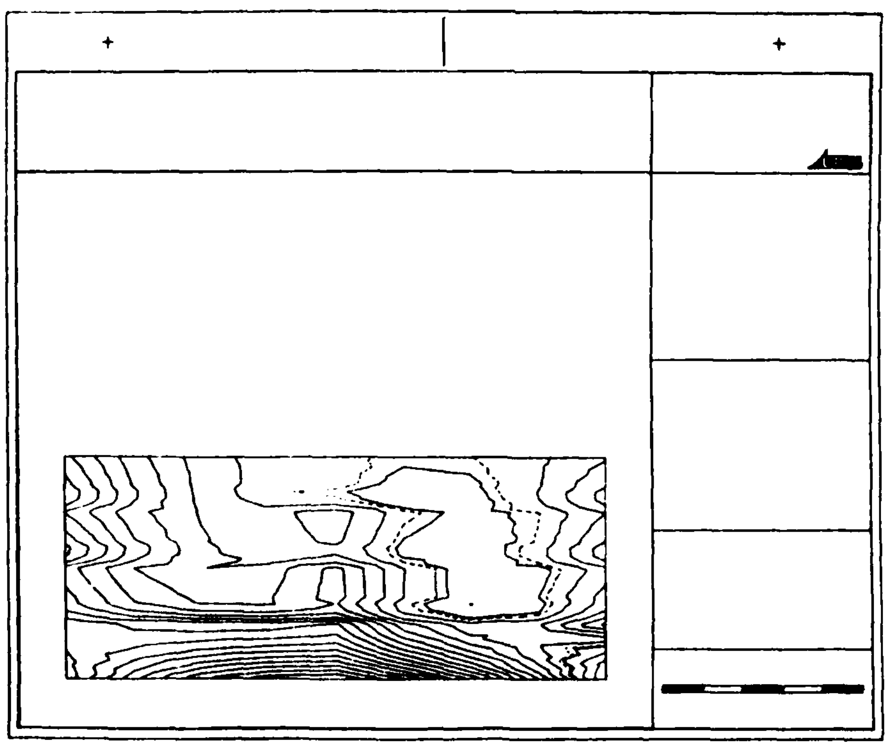

Figure G24. Nonannotated, Y-direction principal stress contours grid I, N = 4 , P-level 2

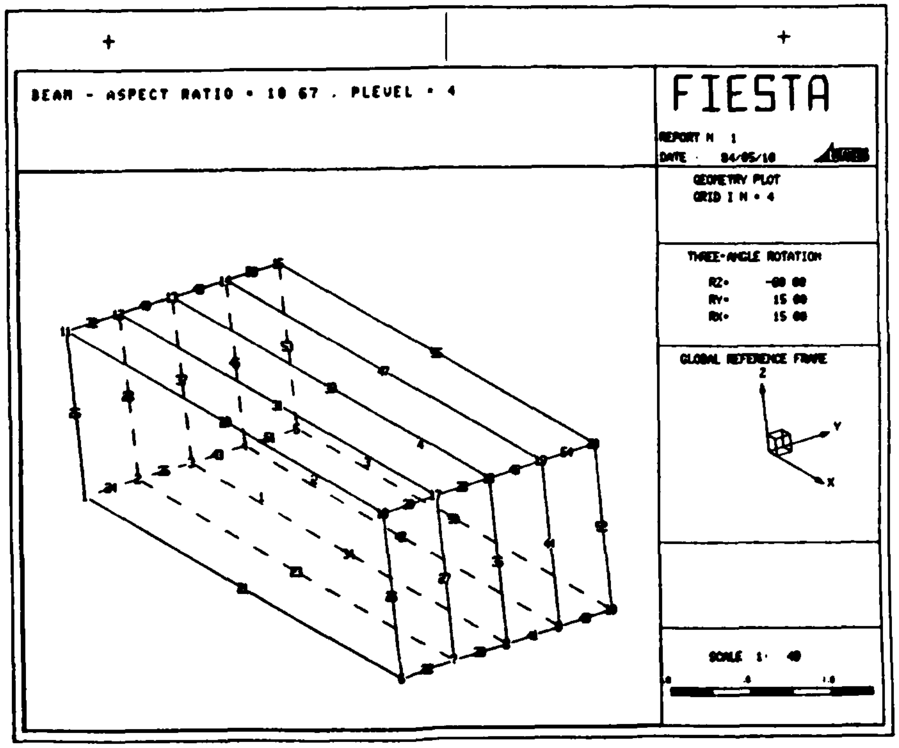

Figure G25. Annotated geometry plot
grid I, N = 4 , P-level 4

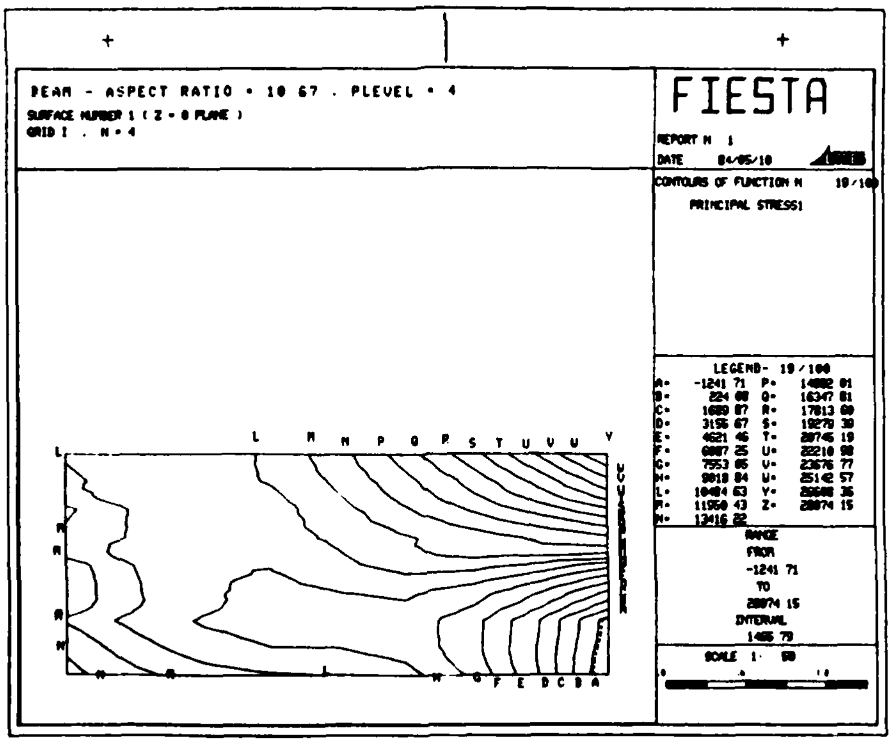

Figure G26. Annotated, X-direction principal stress contours
grid I, N = 4 , P-level 4

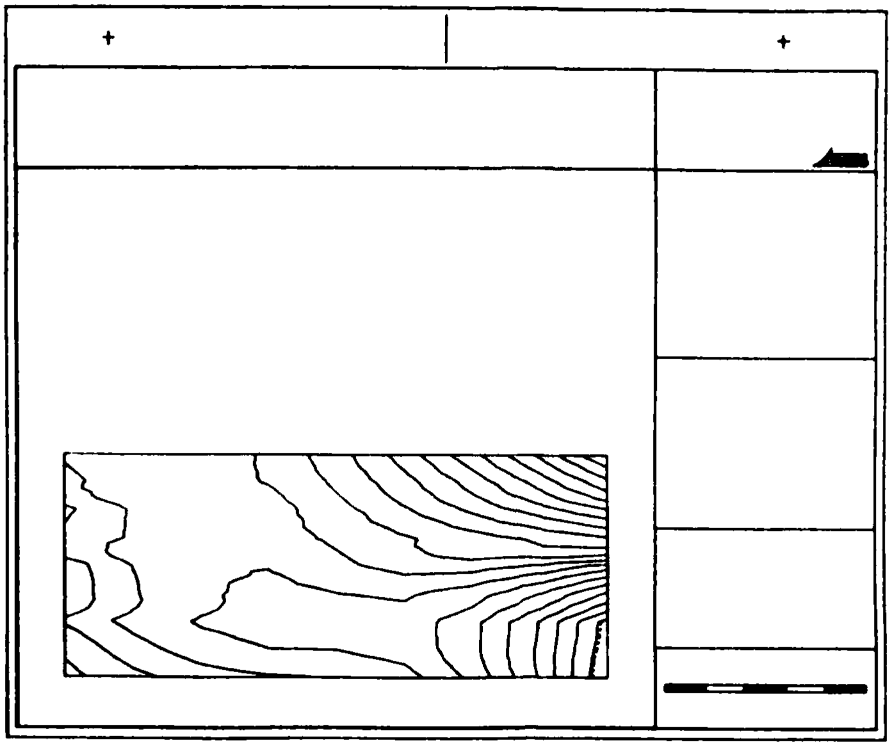

Figure G27. Nonannotated, X-direction principal stress contours grid I, N = 4 , P-level 4

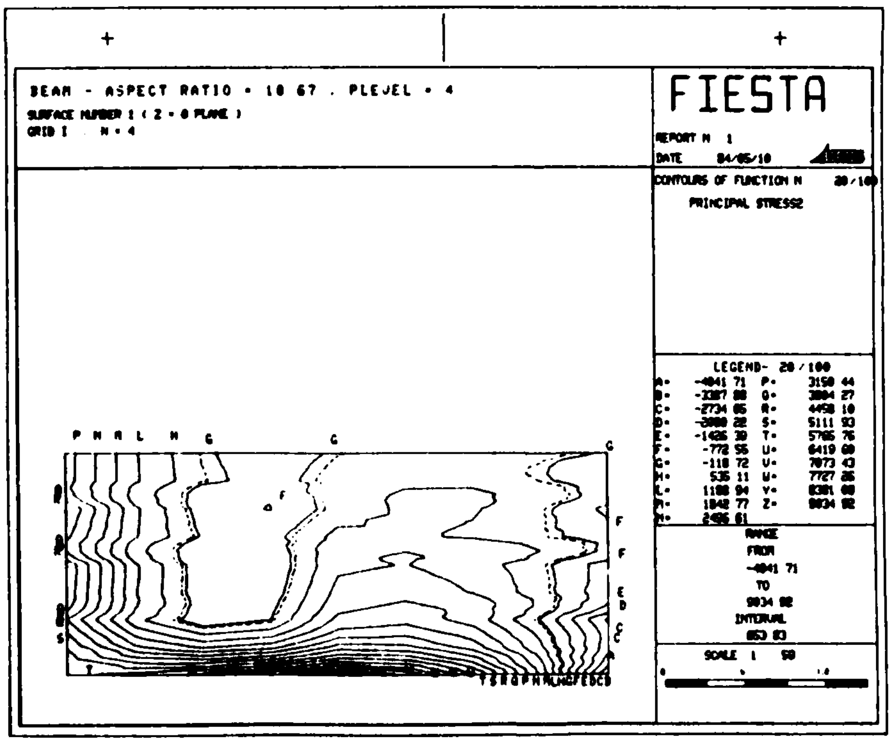

Figure G28. Annotated, Y-direction principal stress contours grid I, N = 4 , P-level 4

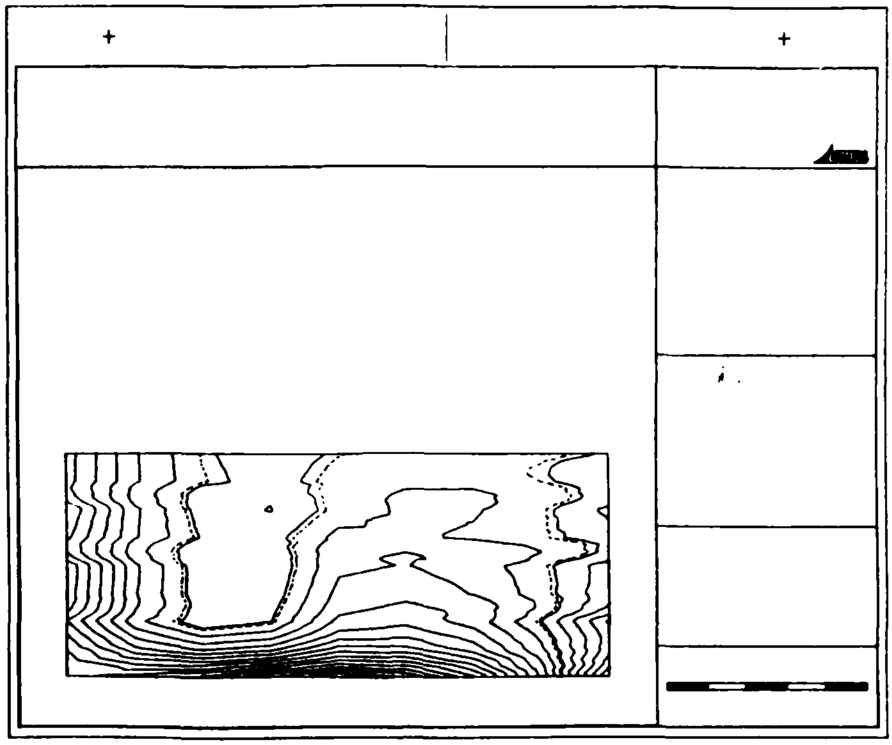

Figure G29. Nonannotated, Y-direction principal stress contours grid I, N = 4 , P-level 4

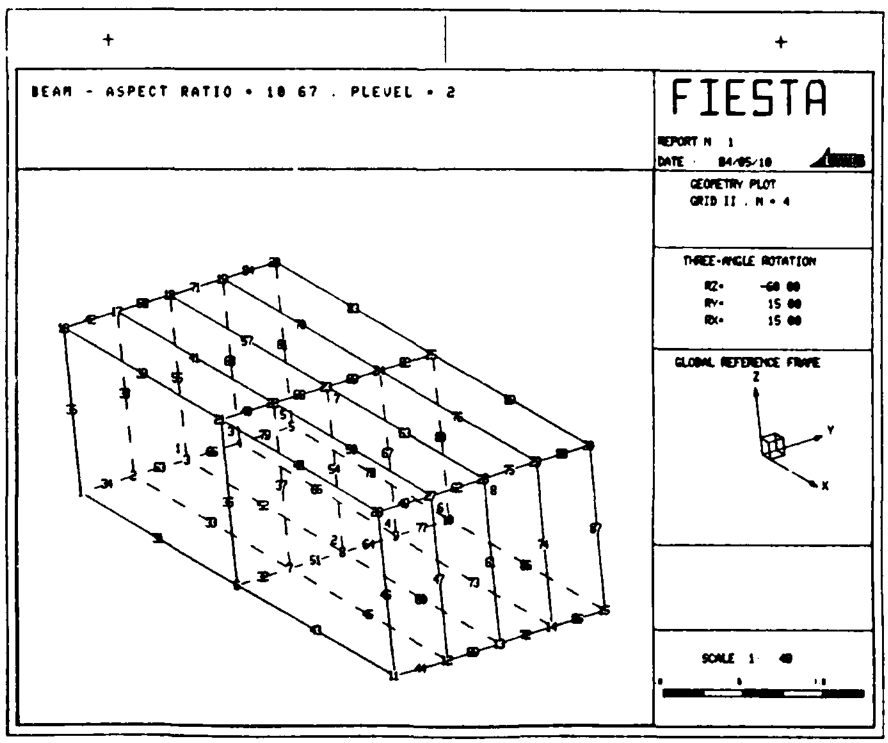

Figure G30. Annotated geometry plot grid II, N = 4 , P-level 2

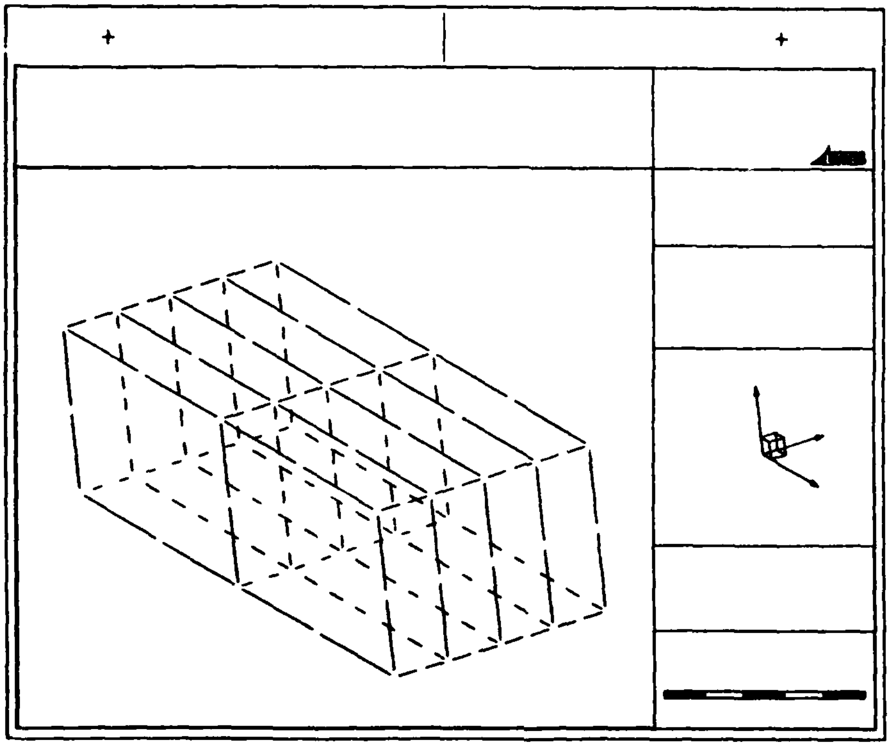

Figure G31. Nonannotated geometry plot
grid II, N = 4 , P-level 2

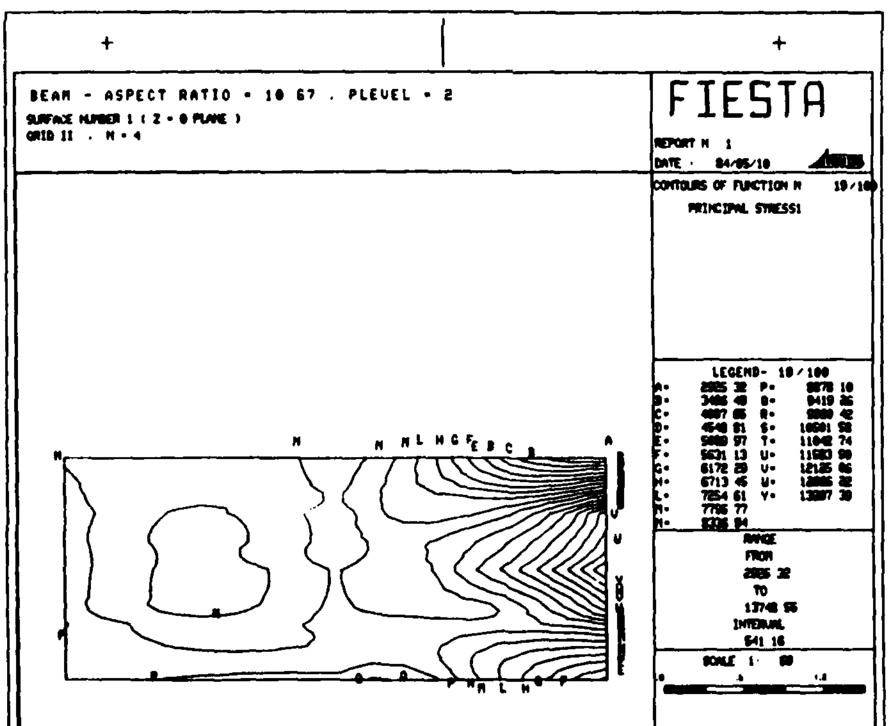

Figure G32. Annotated, X-direction principal stress contours
grid II, N = 4 , P-level 2

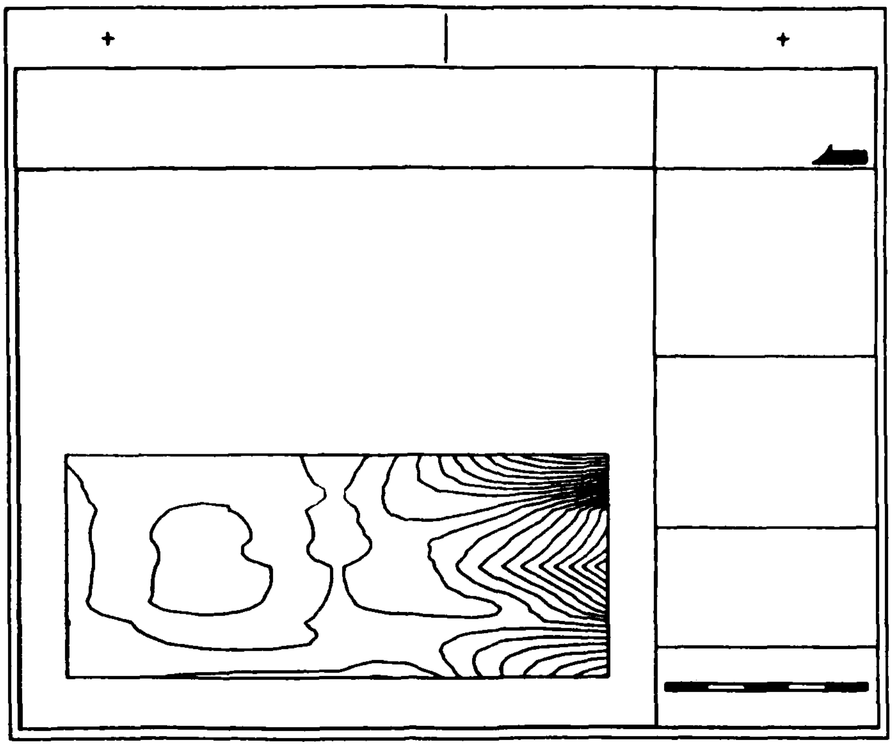

Figure G33. Nonannotated, X-direction principal stress contours grid II, N = 4 , P-level 2

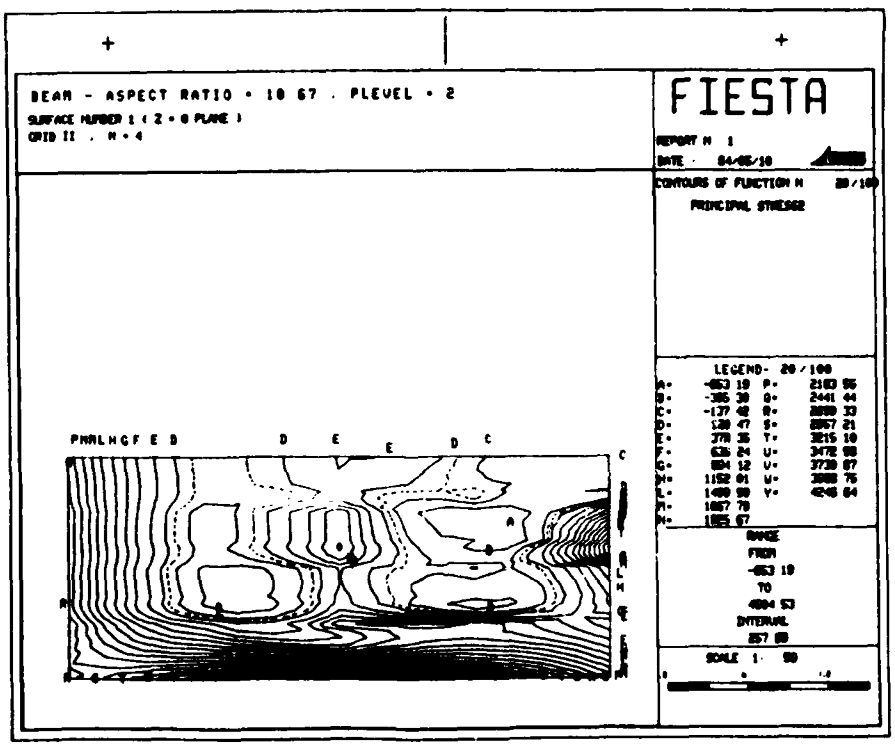

Figure G34. Annotated, Y-direction principal stress contours grid II, N = 4 , P-level 2

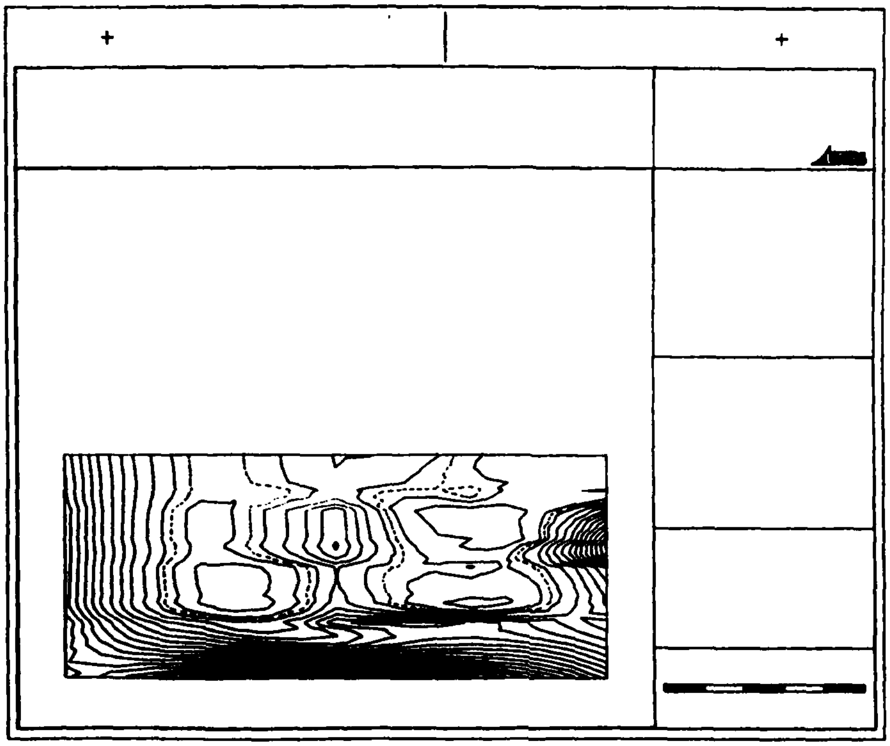

Figure G35. Nonannotated, Y-direction principal stress contours grid II, N = 4 , P-level 2

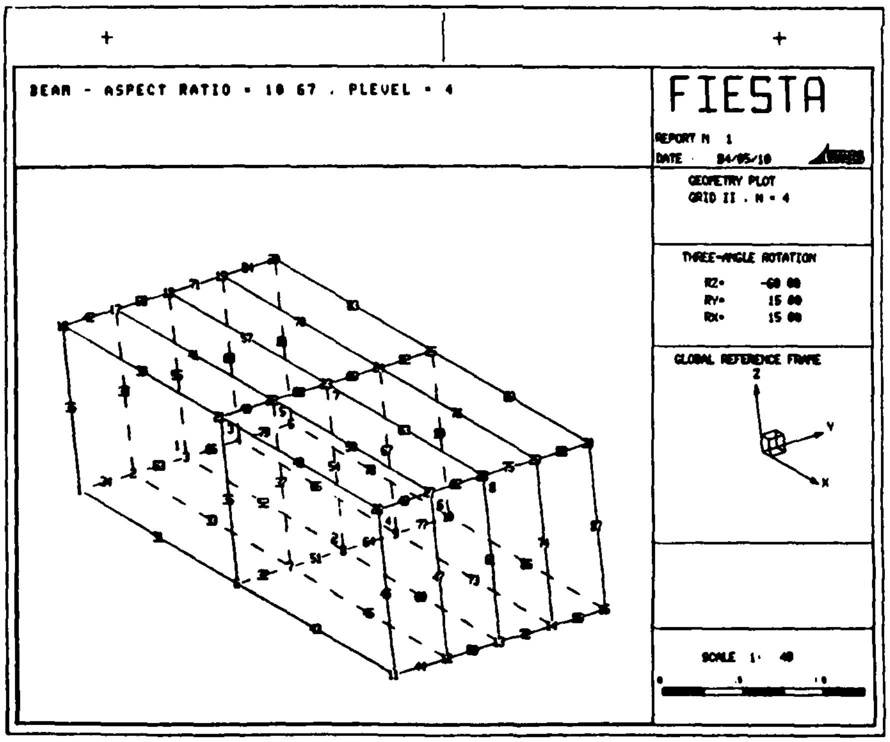

Figure G36. Annotated geometry plot grid II, N = 4 , P-level 4

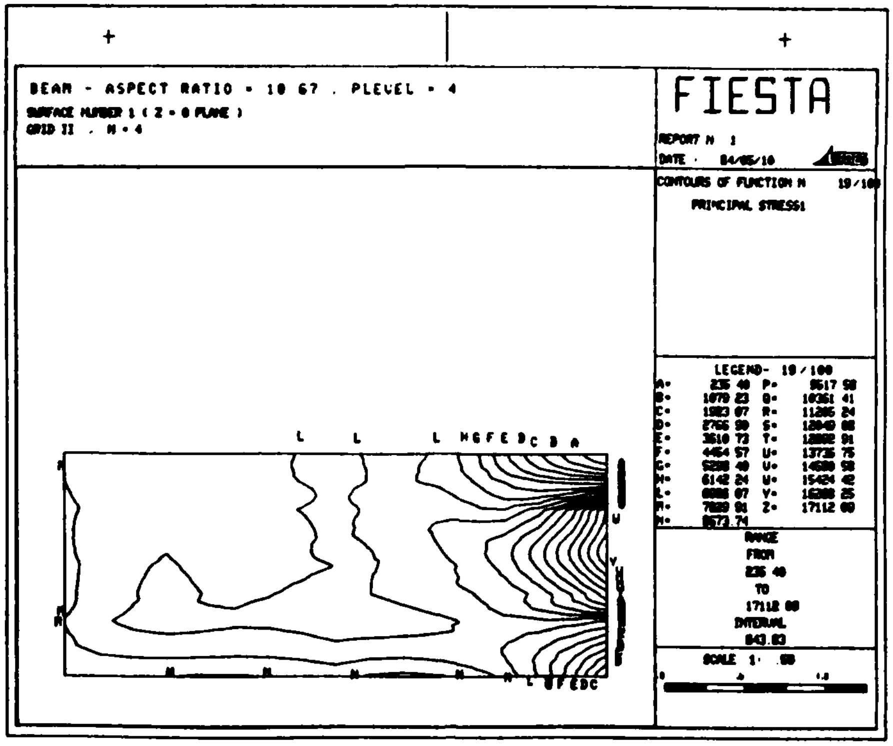

Figure G37. Annotated, X-direction principal stress contours grid II, N = 4 , P-level 4

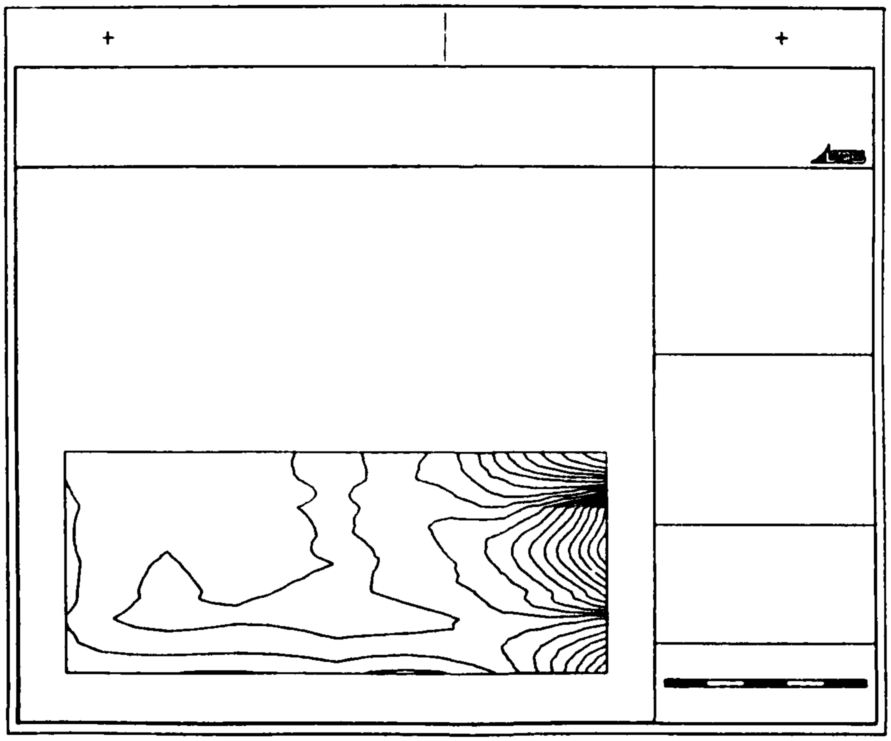

Figure G38. Nonannotated, X-direction principal stress contours grid II, N = 4 , P-level 4

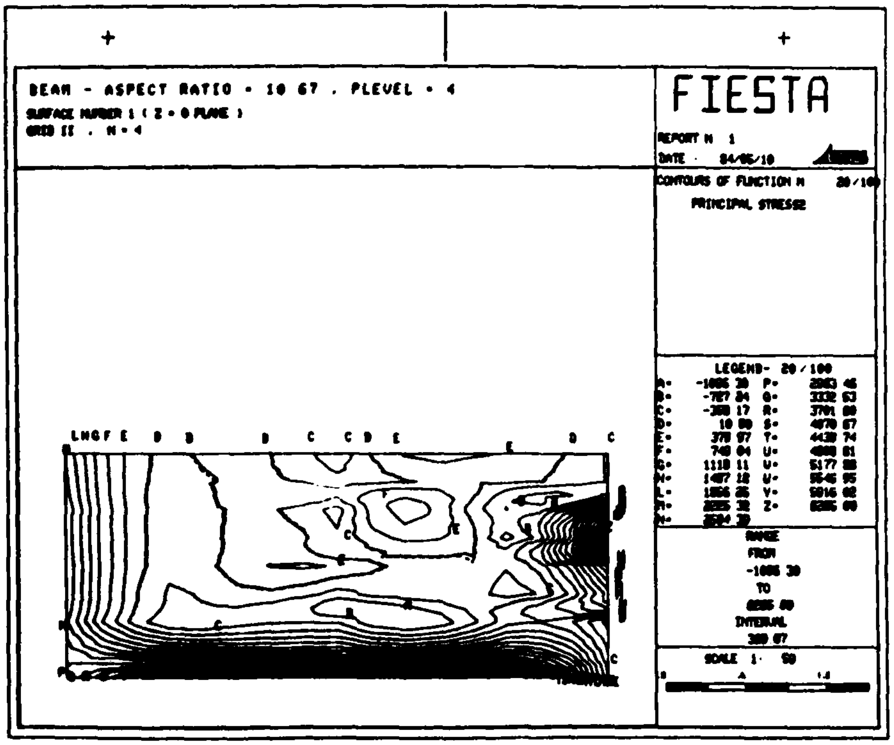

Figure G39. Annotated, Y-direction principal stress contours grid II, N = 4 , P-level 4

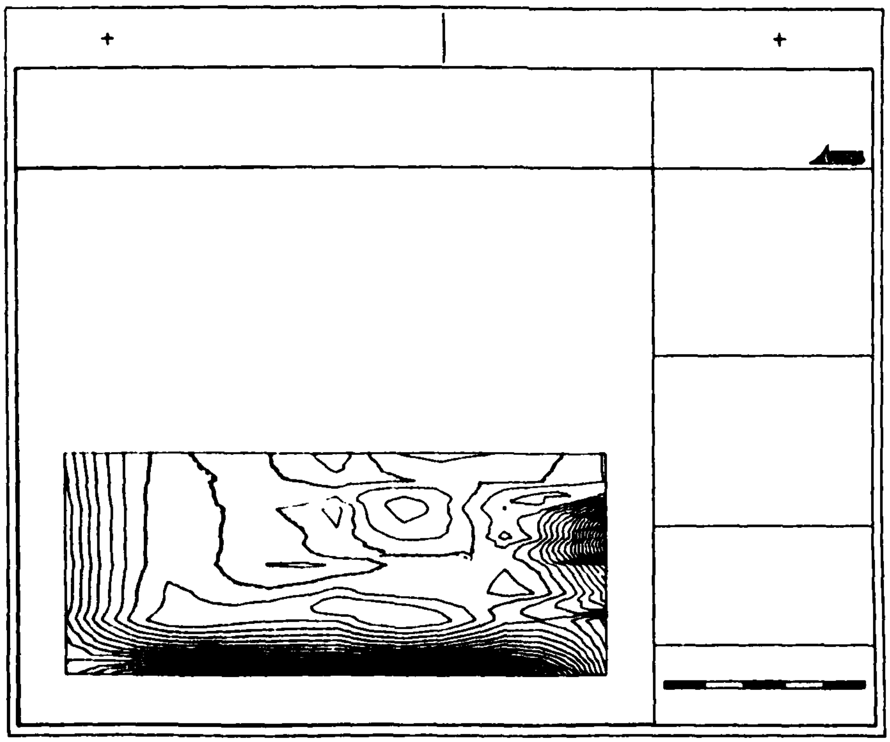

Figure G40. Nonannotated, Y-direction principal stress contours grid II, N = 4 , P-level 4

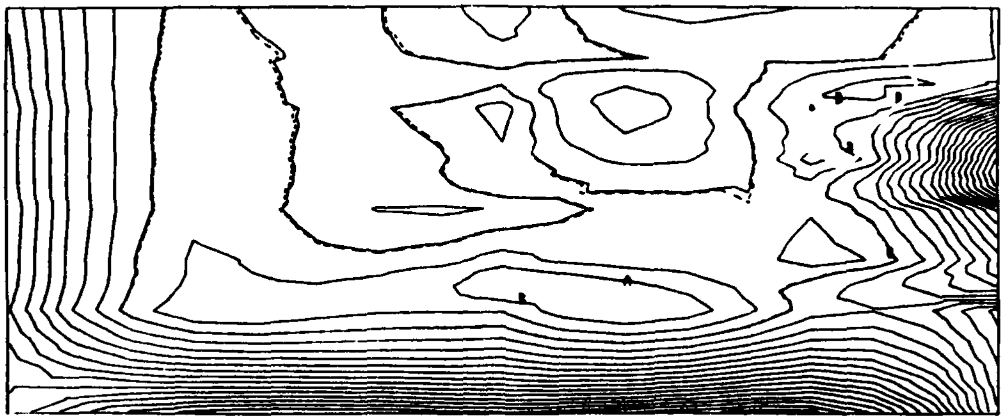

Figure G41. Window of nonannotated, Y-direction principal stress contours
grid II, N = 4 , P-level 4

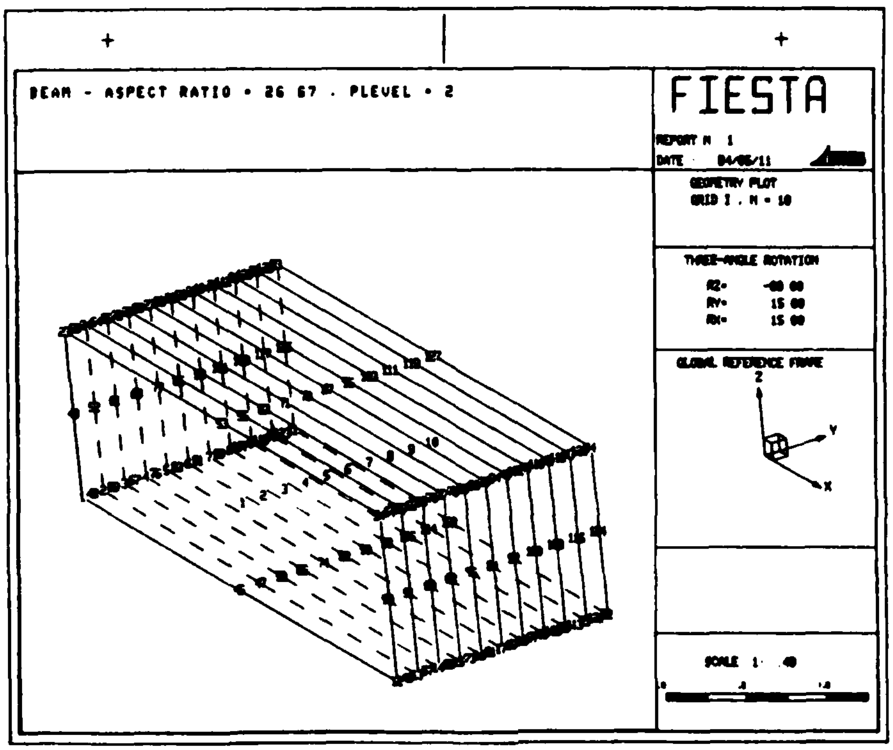

Figure G42. Annotated geometry plot
grid I, N = 10 , P-level 2

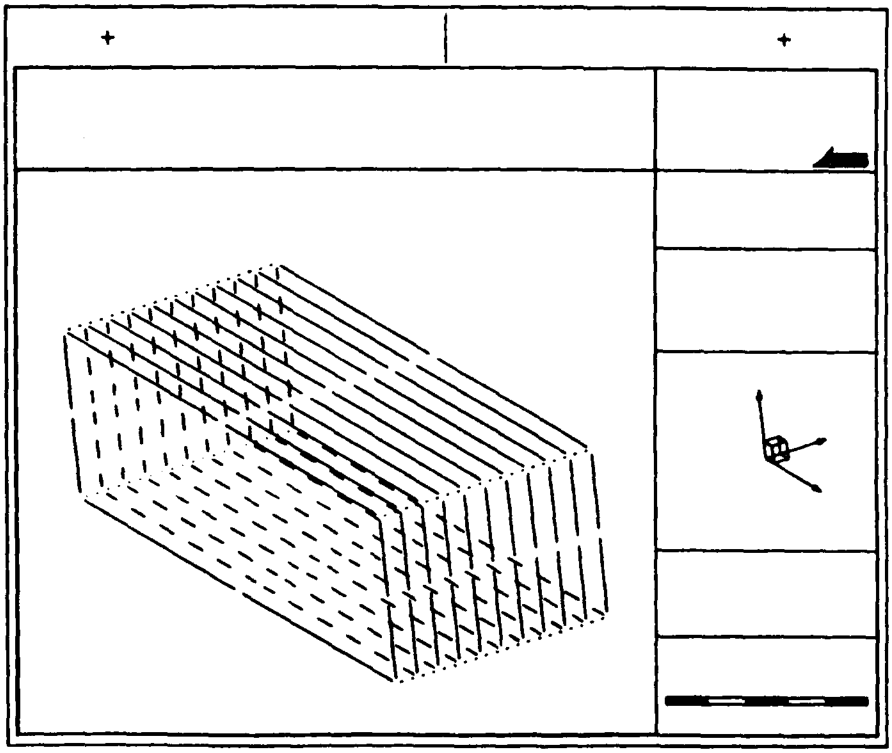

Figure G43. Nonannotated geometry plot
grid I, N = 10 , P-level 2

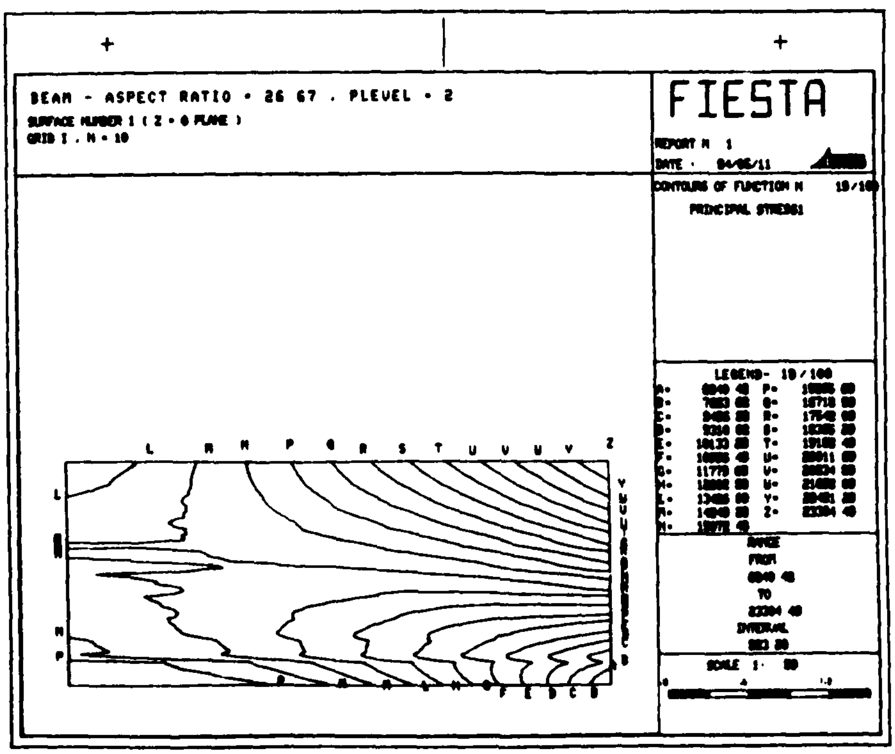

Figure G44. Annotated, X-direction principal stress contours
grid I, N = 10 , P-level 2

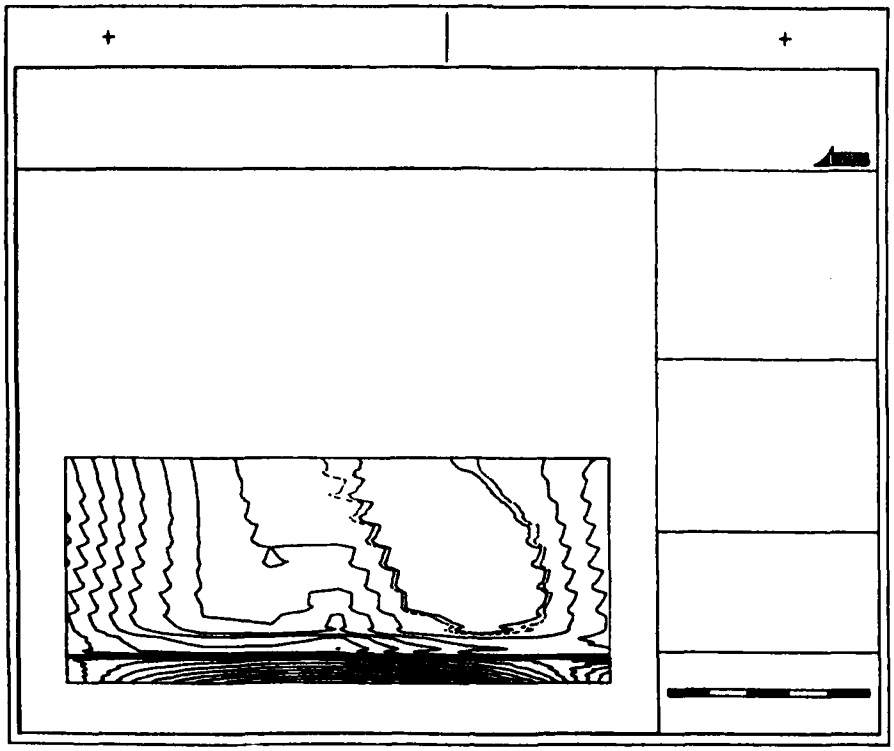

Figure G45. Nonannotated, X-direction principal stress contours grid I, N = 10 , P-level 2

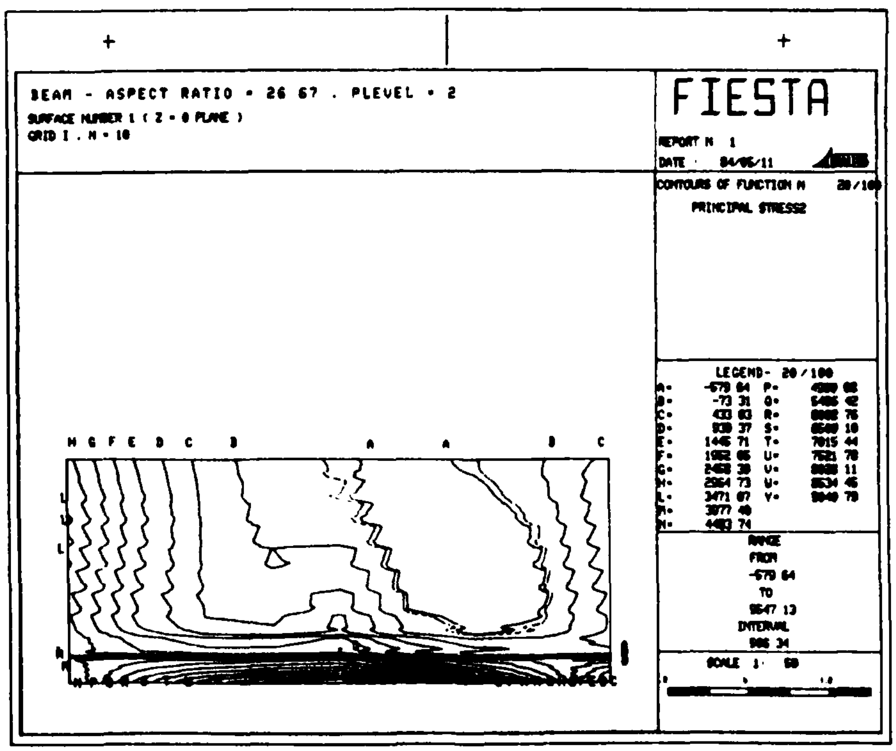

Figure G46. Annotated, Y-direction principal stress contours grid I, N = 10 , P-level 2

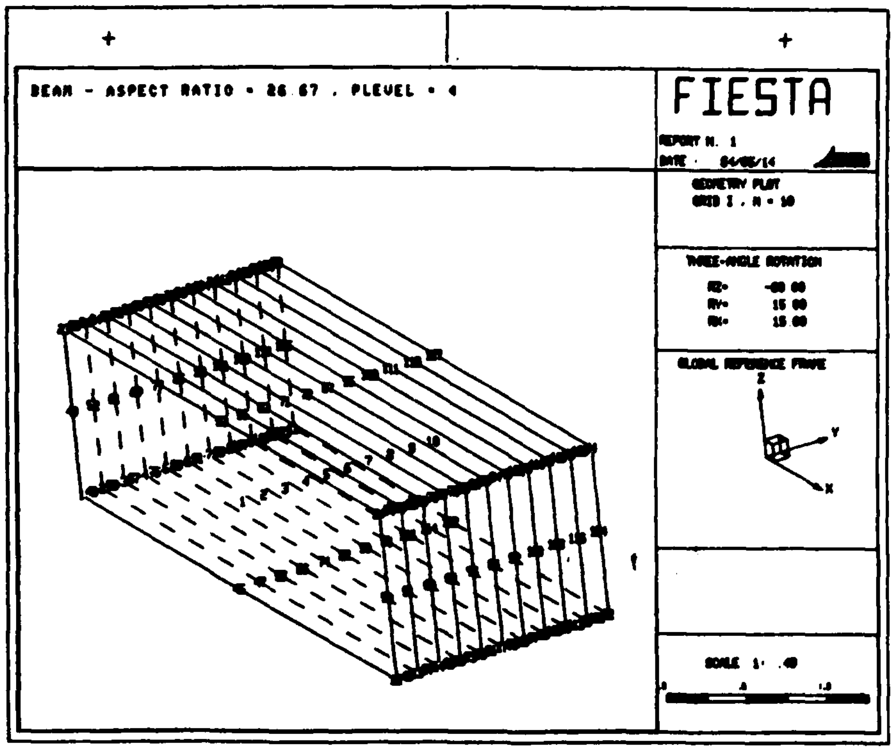

Figure G47. Annotated geometry plot
grid I, N = 10 , P-level 4

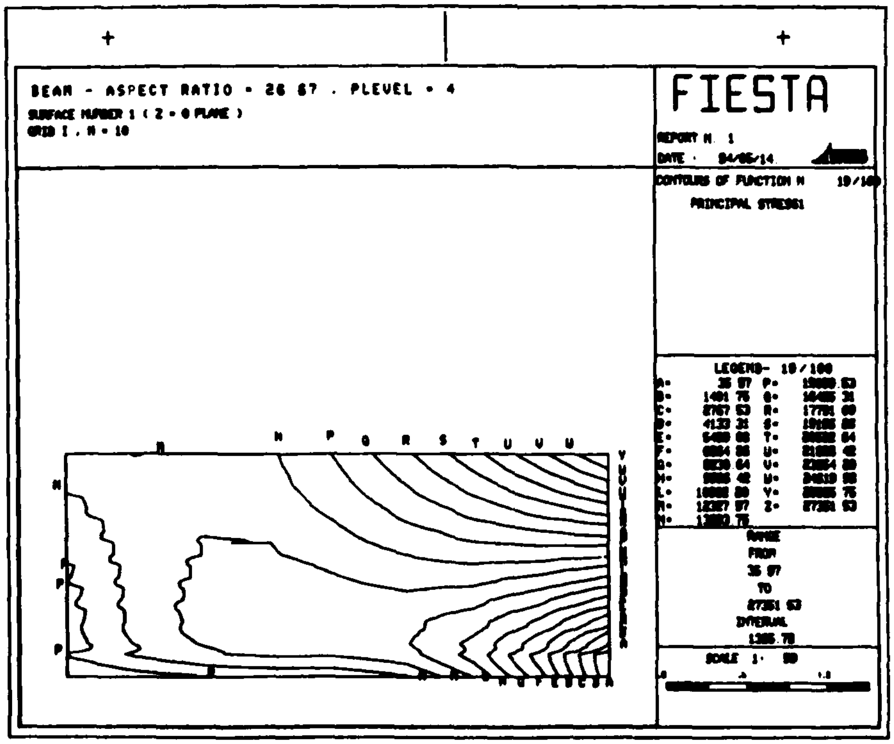

Figure G48. Annotated, X-direction principal stress contours
grid I, N = 10 , P-level 4

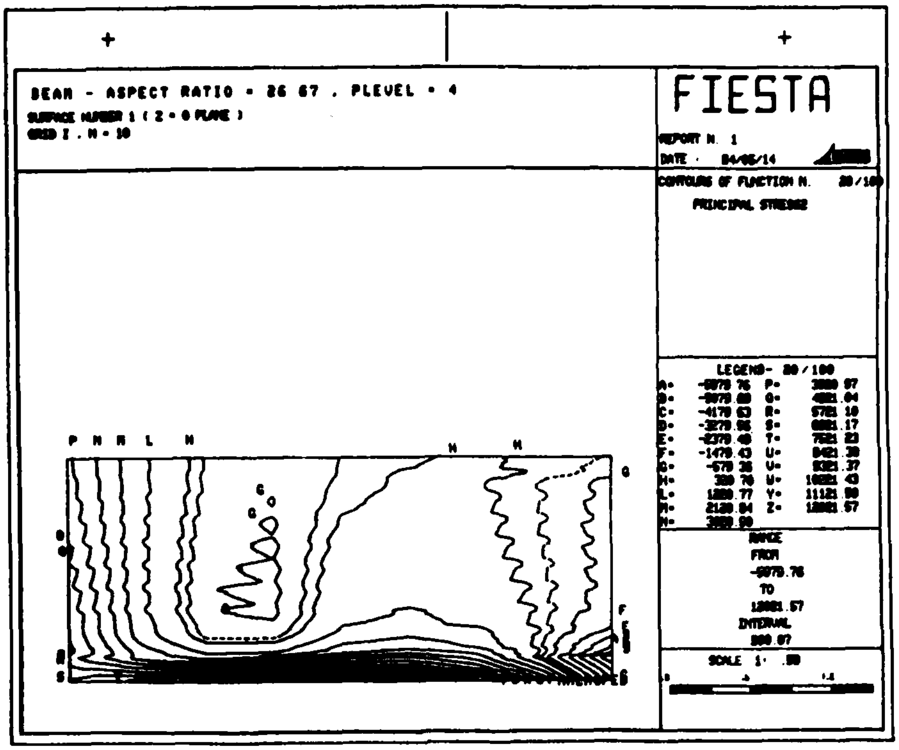

Figure G49. Annotated, Y-direction principal stress contours
grid I, N = 10 , P-level 4

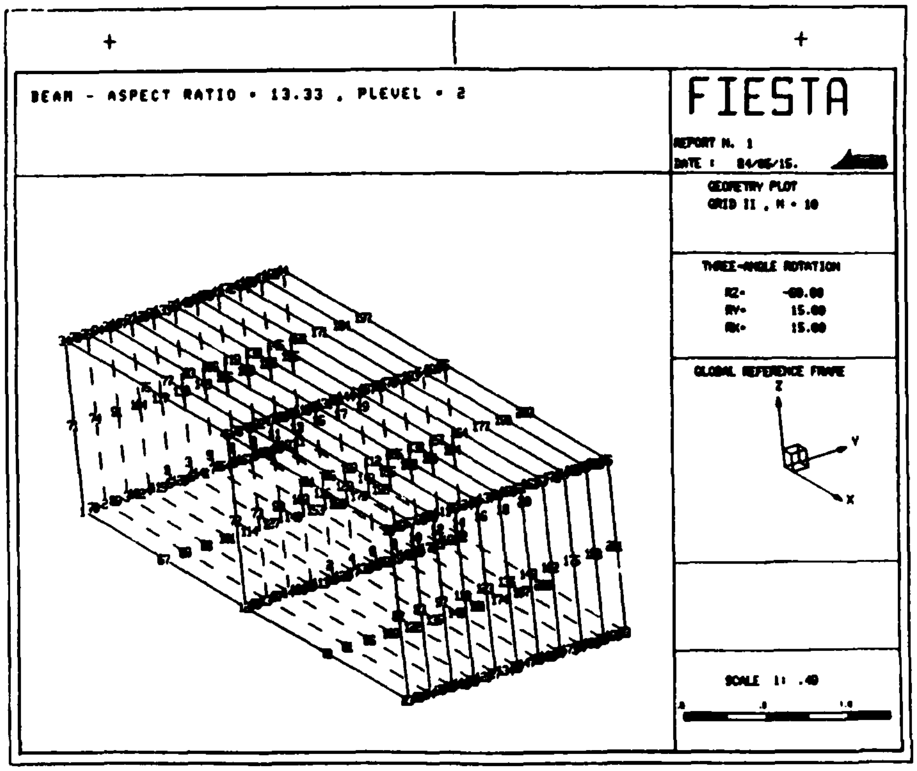

Figure G50. Annotated geometry plot
grid II, N = 10 , P-level 2

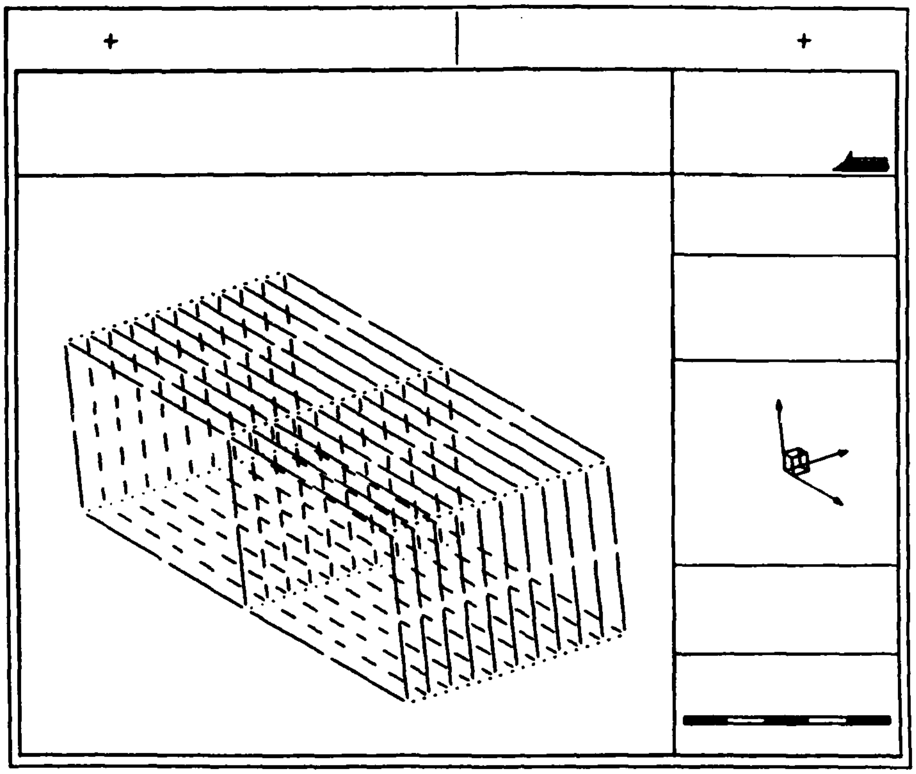

Figure G51. Nonannotated geometry plot
grid II, N = 10 , P-level 2

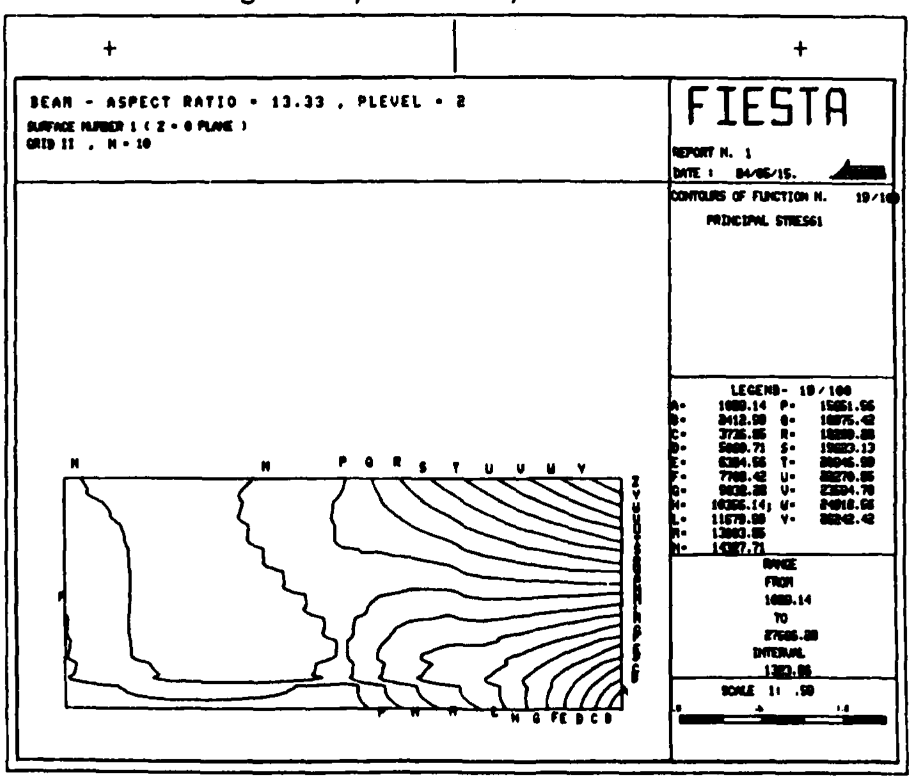

Figure G52. Annotated, X-direction principal stress contours
grid II, N = 10 , P-level 2

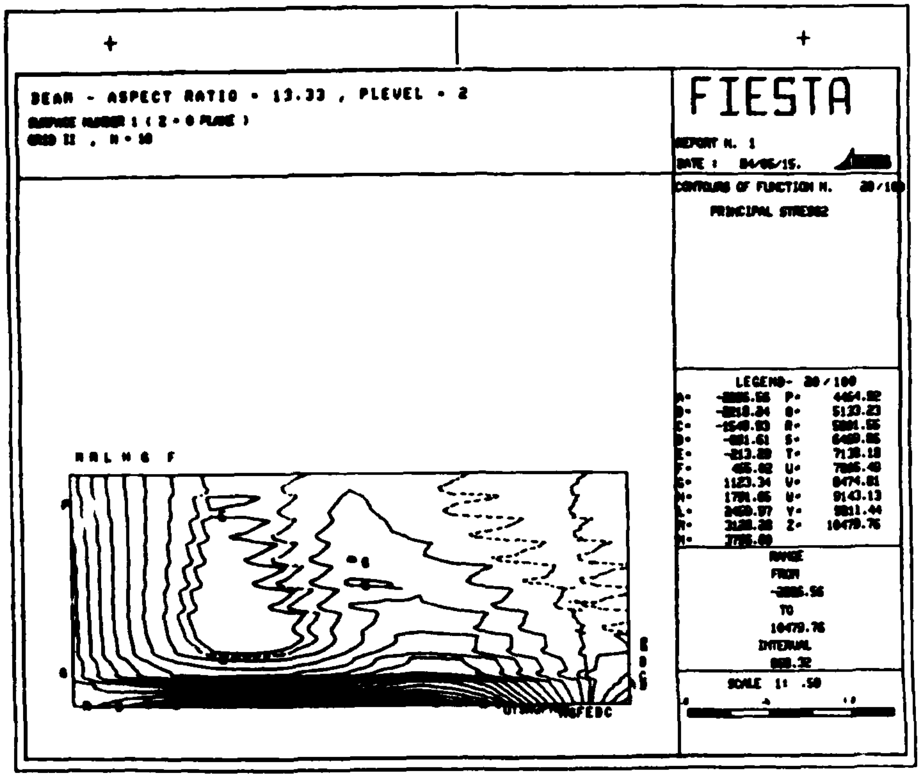

Figure G53. Annotated, Y-direction principal stress contours
grid II, N = 10 , P-level 2

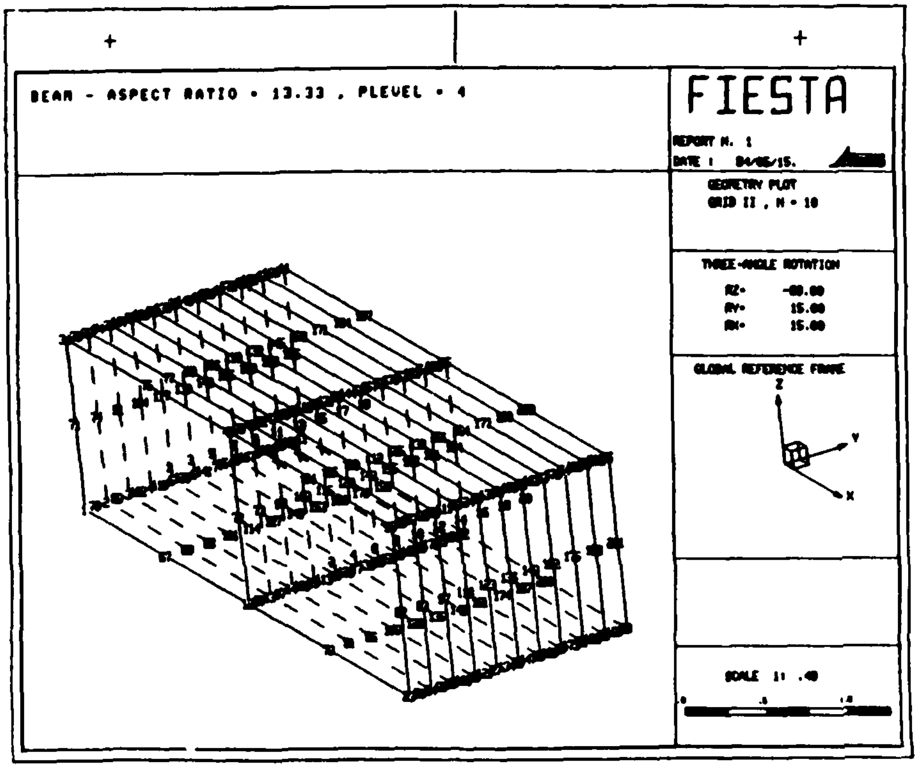

Figure G54. Annotated geometry plot
grid II, N = 10 , P-level 4

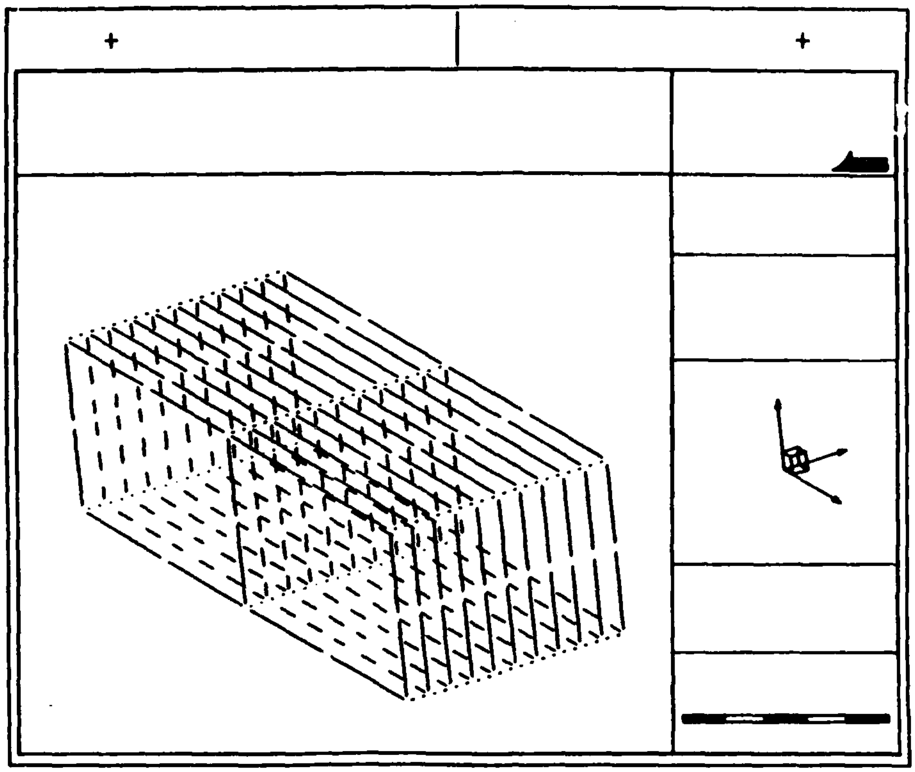

Figure G55. Nonannotated geometry plot
grid II, N = 10 , P-level 4

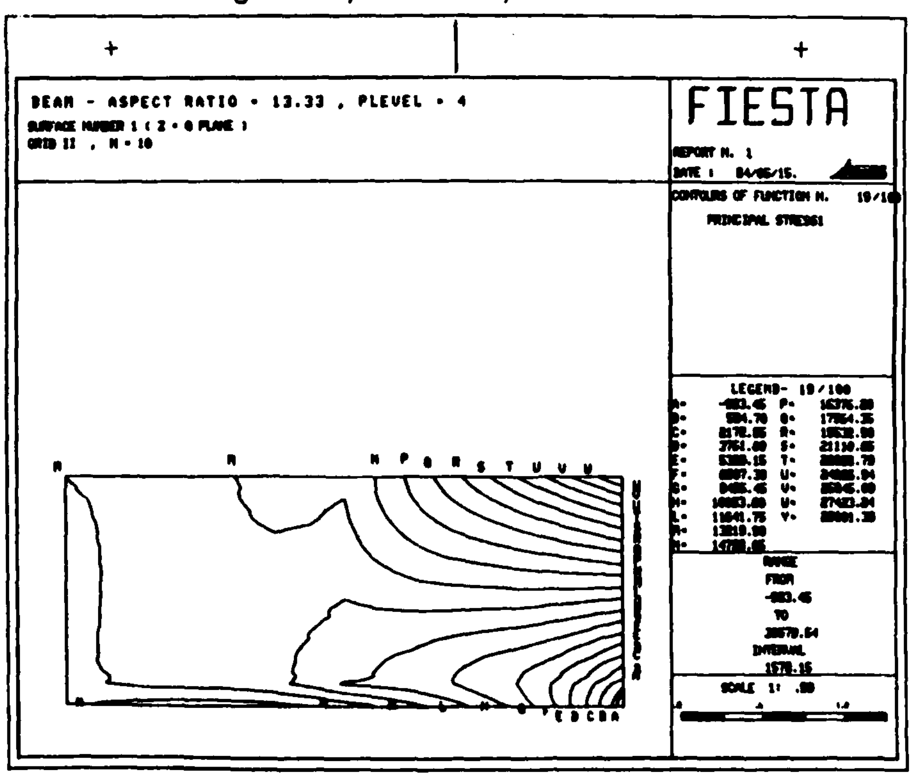

Figure G56. Annotated, X-direction principal stress contours
grid II, N = 10 , P-level 4

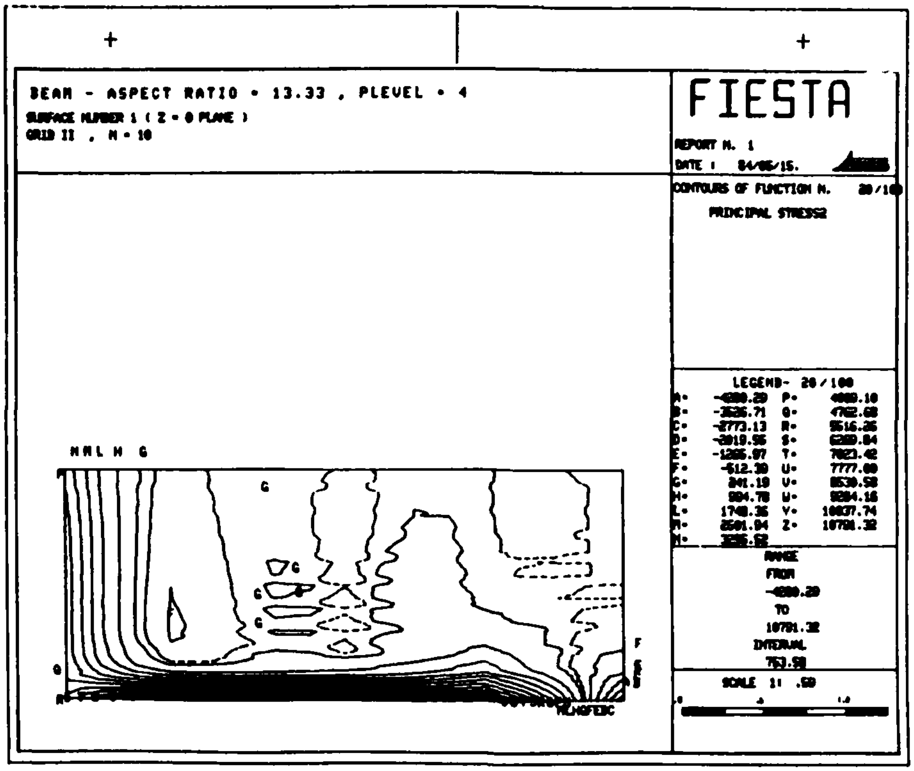

Figure G57. Annotated, Y-direction principal stress contours
grid II, N = 10 , P-level 4

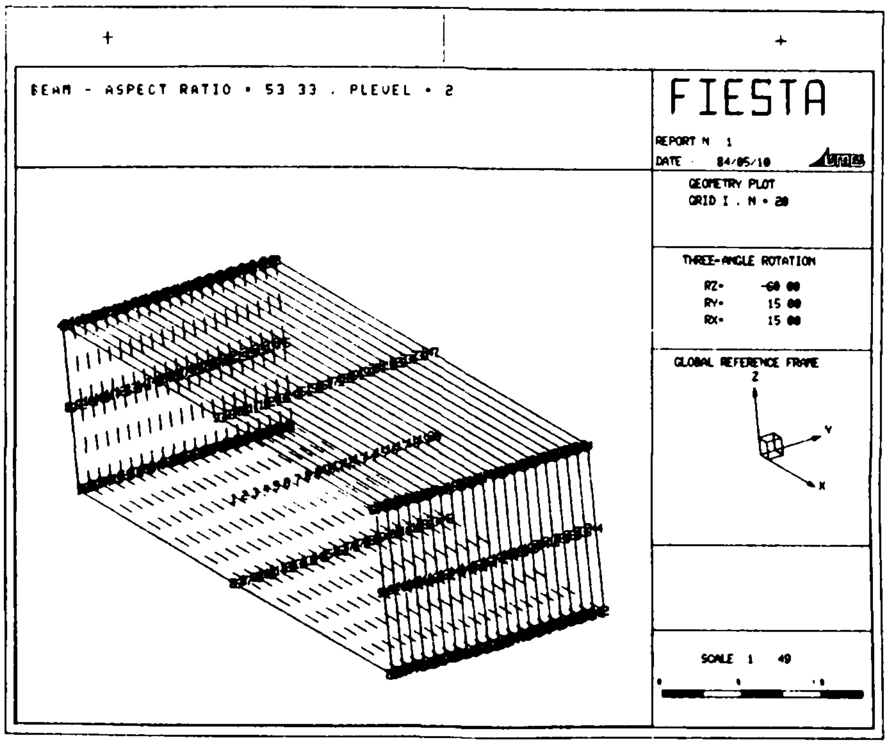

Figure G58. Annotated geometry plot
grid I, N = 20 , P-level 2

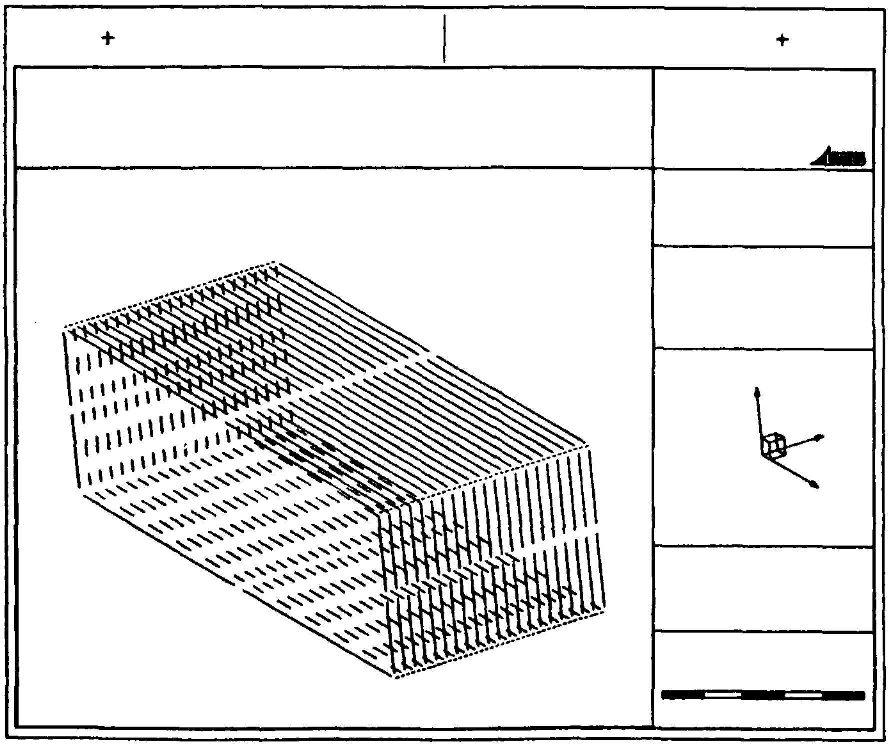

Figure G59. Nonannotated geometry plot
grid I, N = 20 , P-level 2

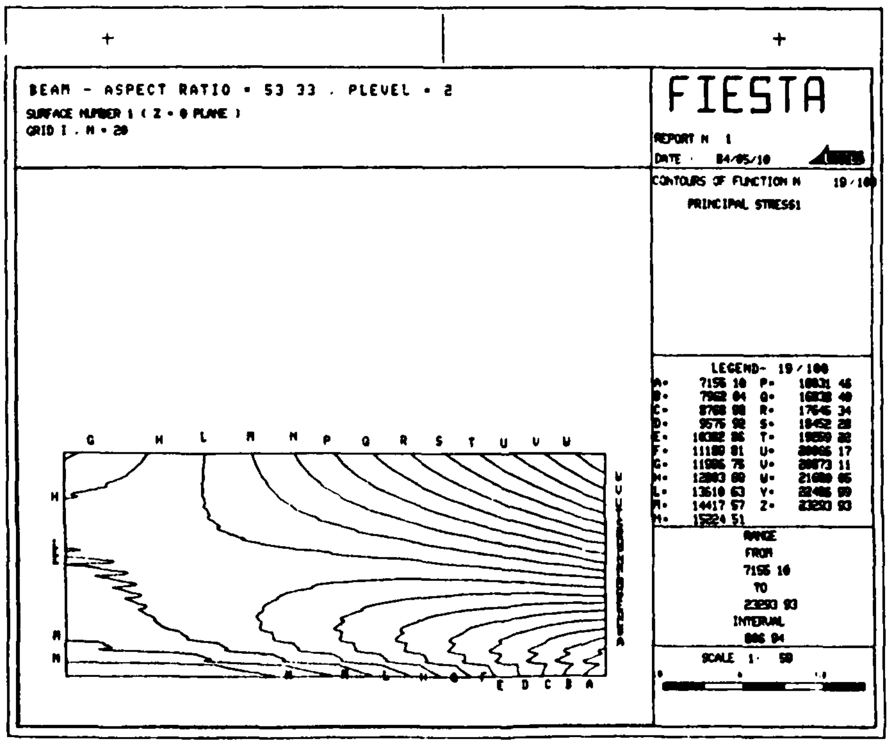

Figure G60. Annotated, X-direction principal stress contours
grid I, N = 20 , P-level 2

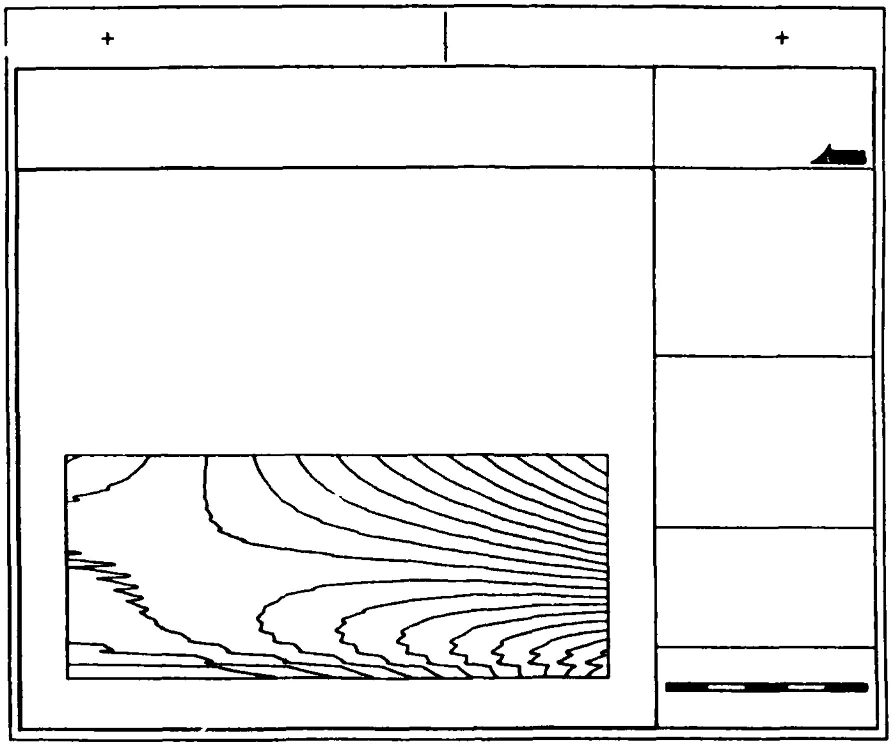

Figure G61. Nonannotated, X-direction principal stress contours grid I, N = 20 , P-level 2

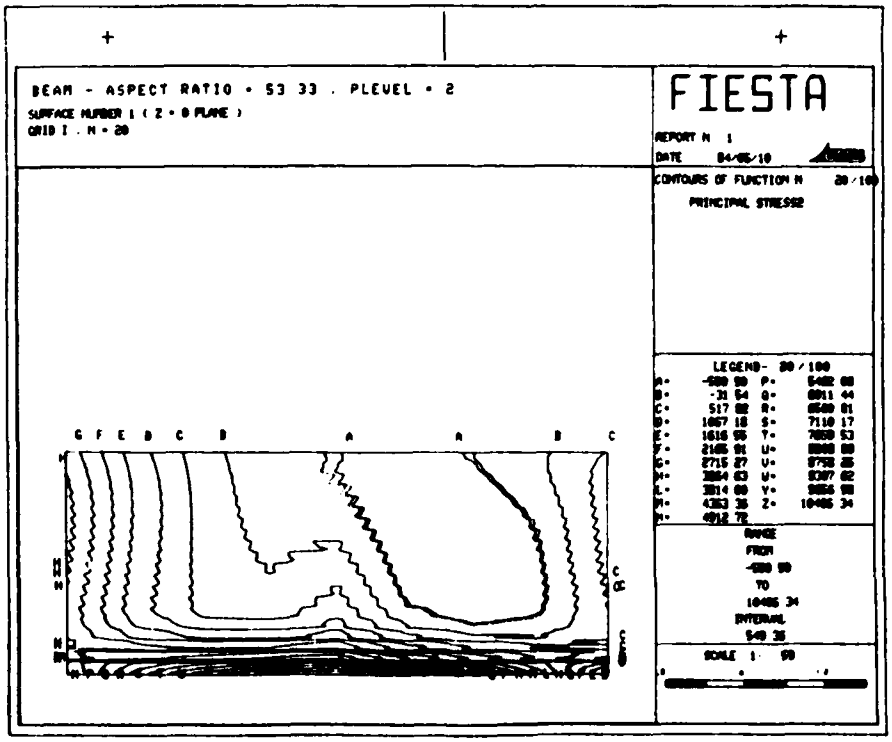

Figure G62. Annotated, Y-direction principal stress contours grid I, N = 20 , P-level 2

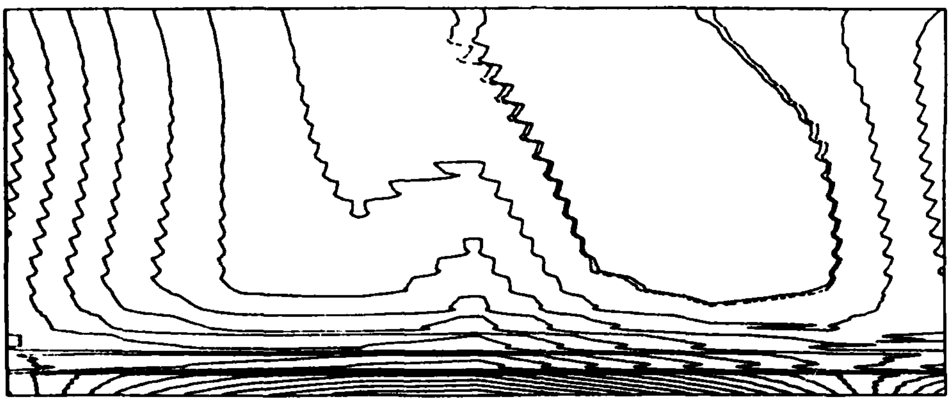

Figure G63. Nonannotated window of Y-direction principal stress contours grid I, N = 20 , P-level 2

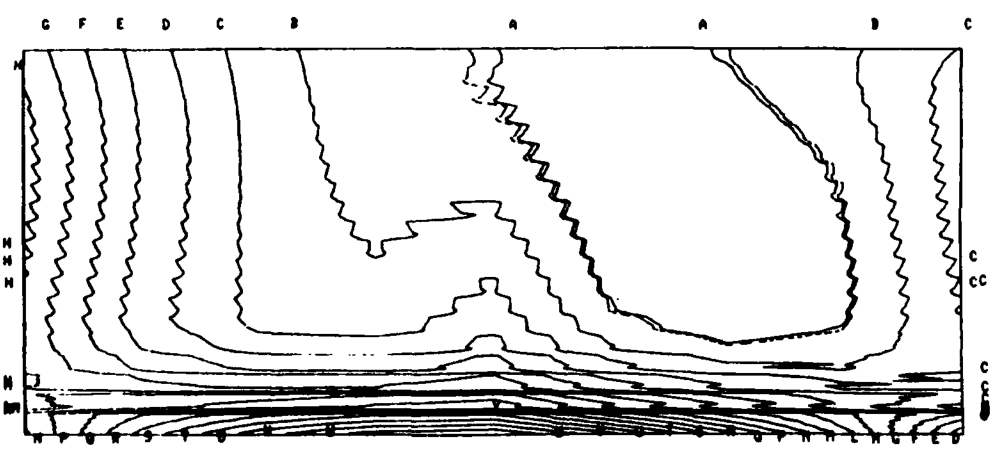

Figure G64. Annotated window of Y-direction principal stress contours grid I, N = 20 , P-level 2

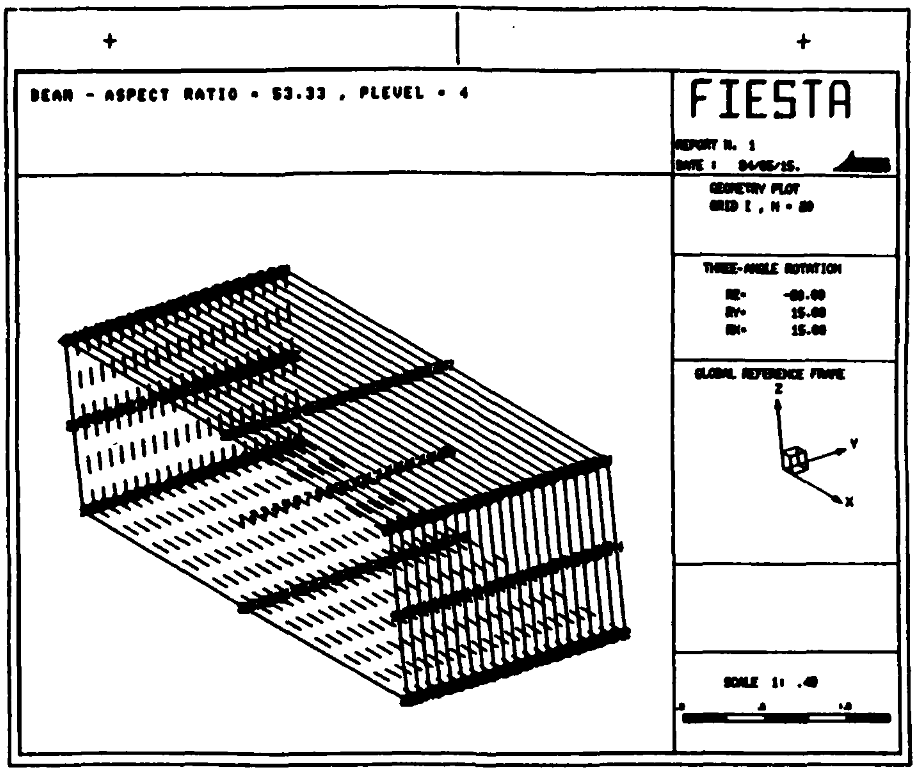

Figure G65. Annotated geometry plot
grid I, N = 20 , P-level 4

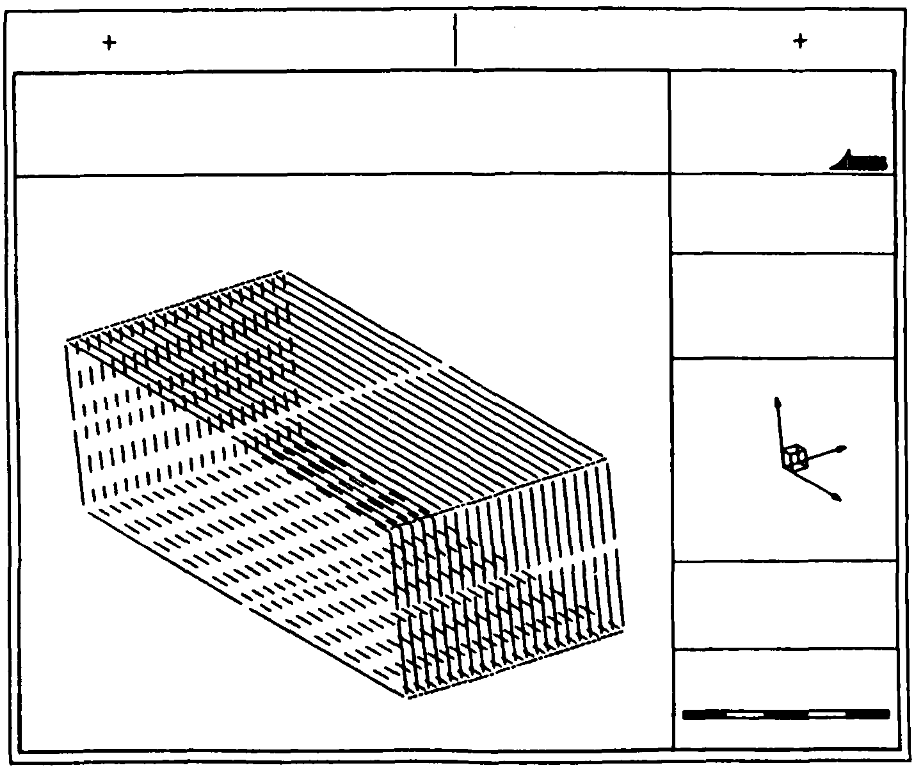

Figure G66. Nonannotated geometry plot
grid I, N = 20 , P-level 4

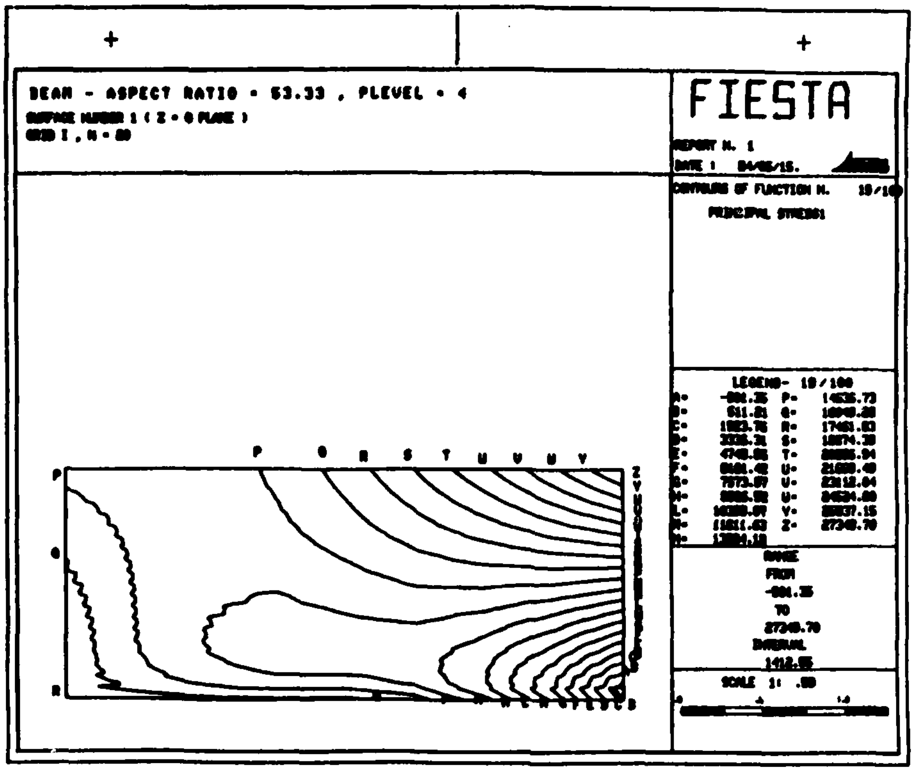

Figure G67. Annotated, X-direction principal stress contours grid I, N = 20 , P-level 4

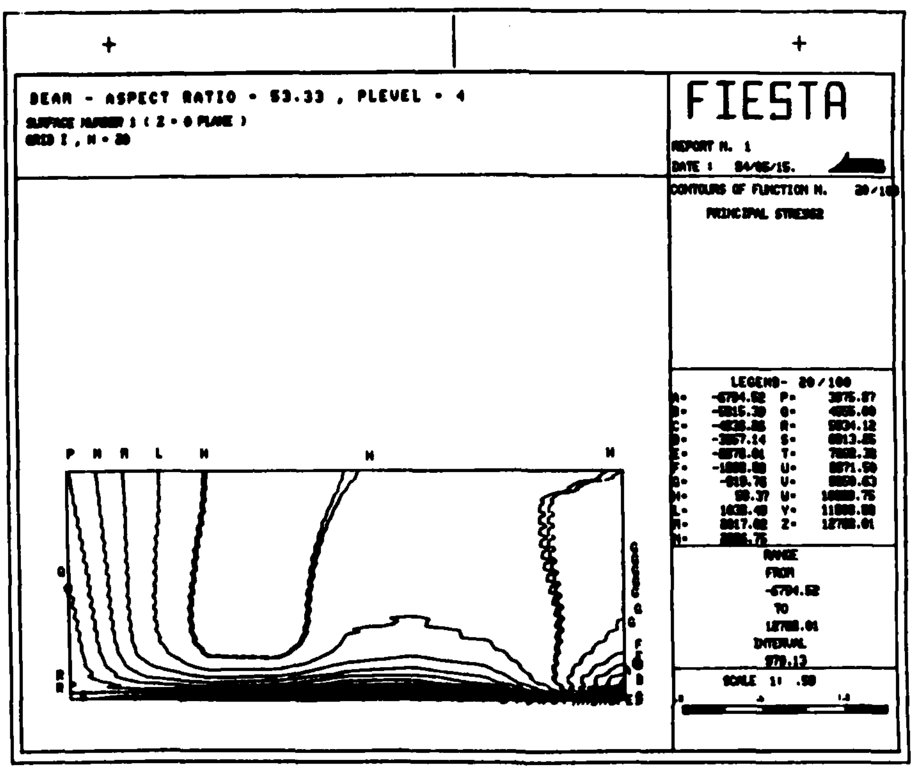

Figure G68. Annotated, Y- direction principal stress contours grid I, N = 20 , P-level 4

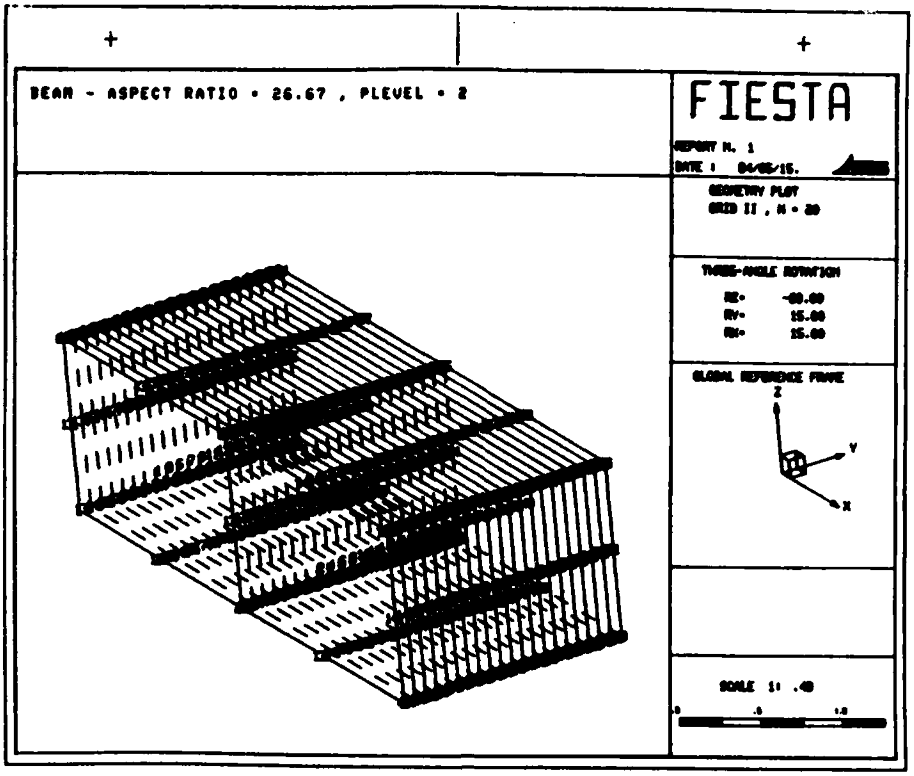

Figure G69. Annotated geometry plot
grid II, N = 20 , P-level 2

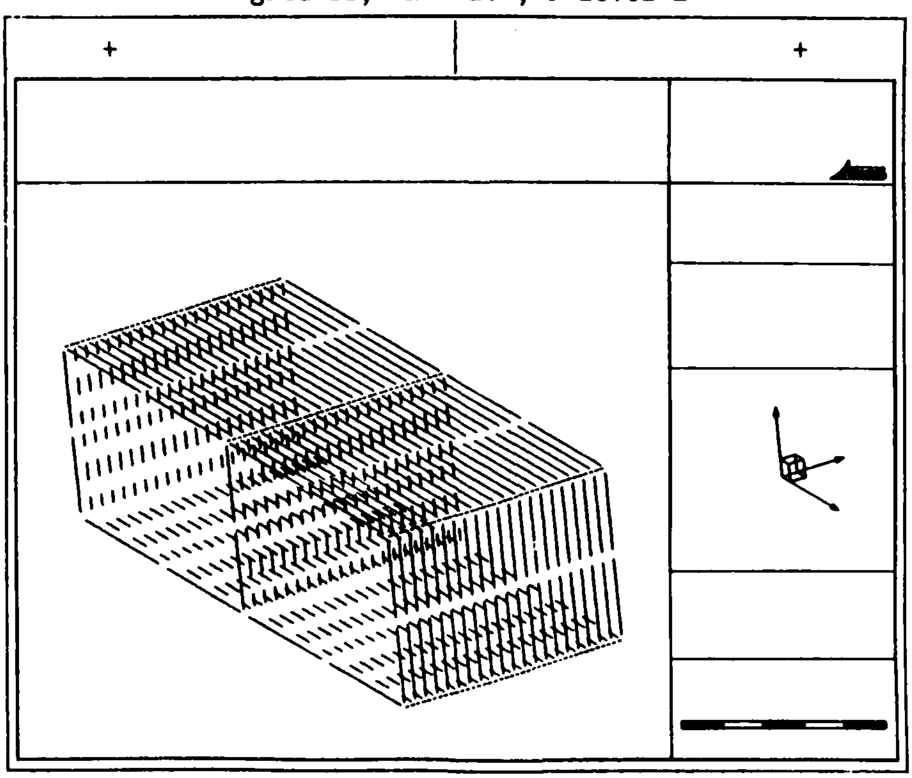

Figure G70. Nonannotated geometry plot
grid II, N = 20 , P-level 2

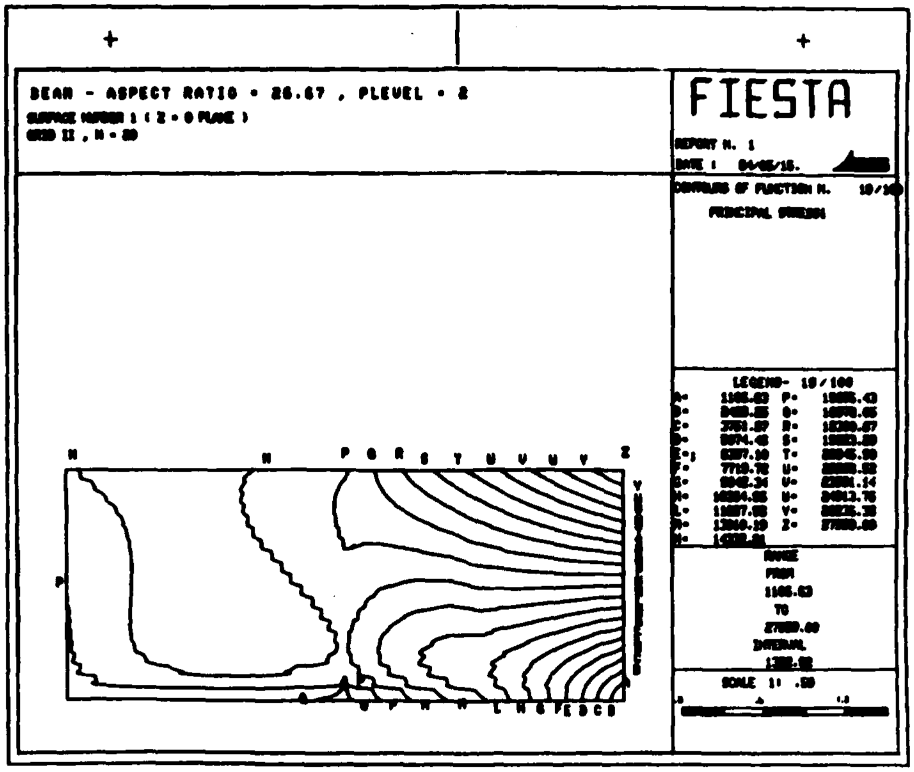

Figure G71. Annotated, X-direction principal stress contours
grid II, N = 20 , P-level 2

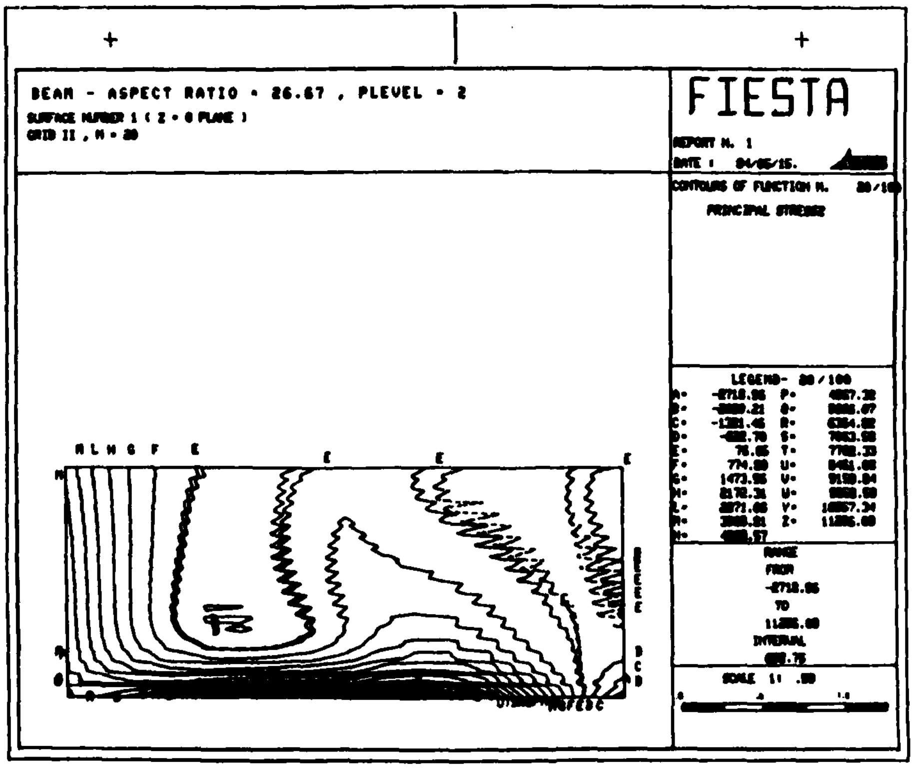

Figure G72. Annotated, Y-direction principal stress contours
grid II, N = 20 , P-level 2

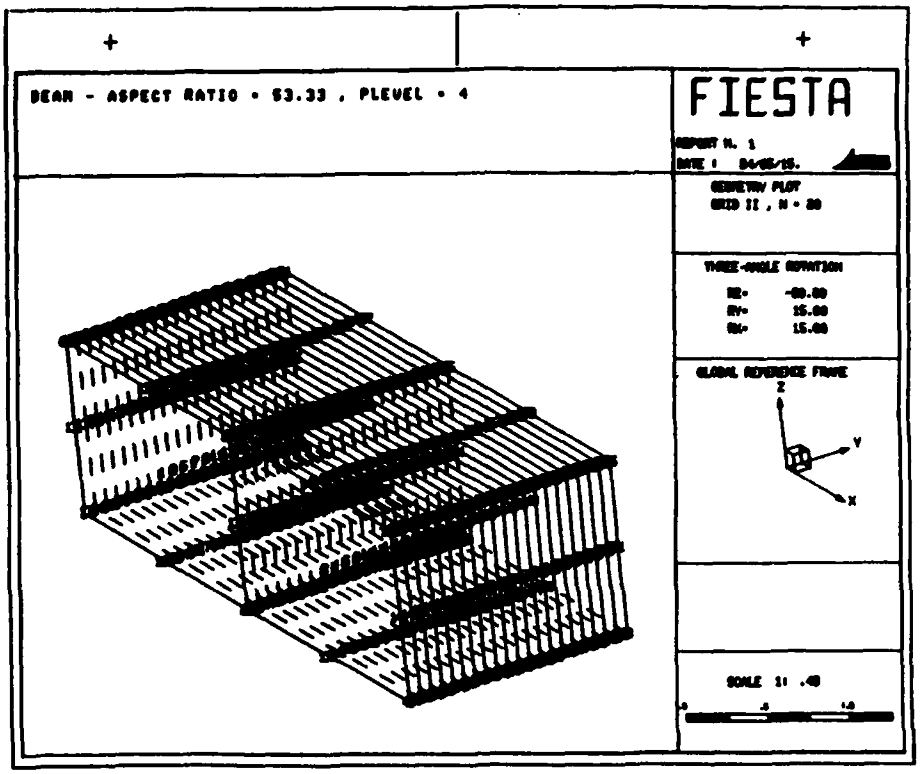

Figure G73. Annotated geometry plot
grid II, N = 20 , P-level 4

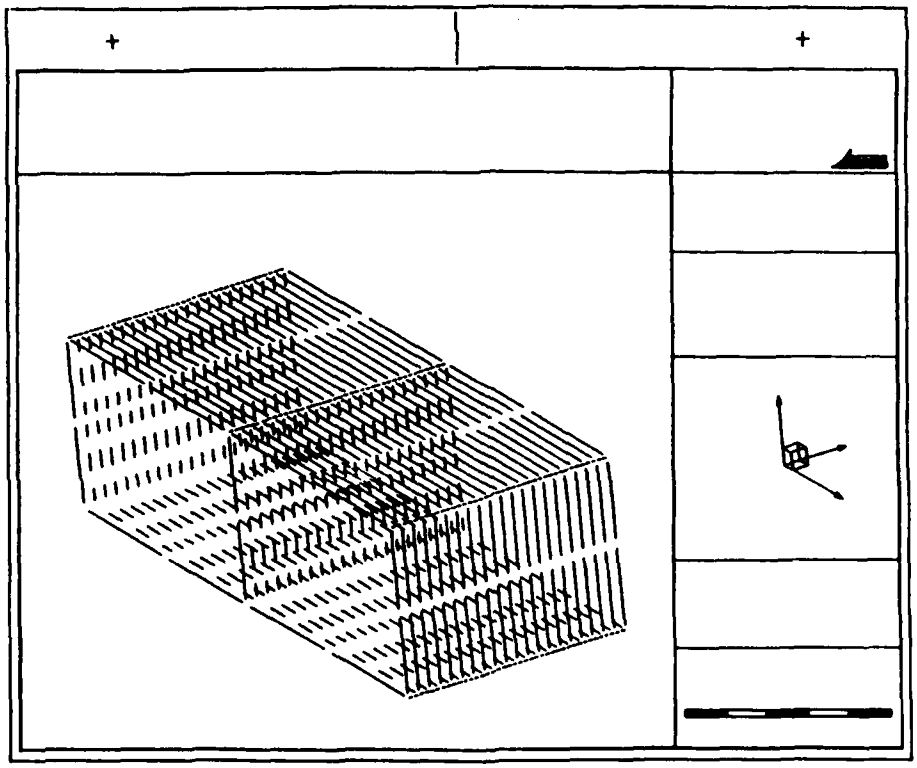

Figure G74. Nonannotated geometry plot
grid II, N = 20 , P-level 4

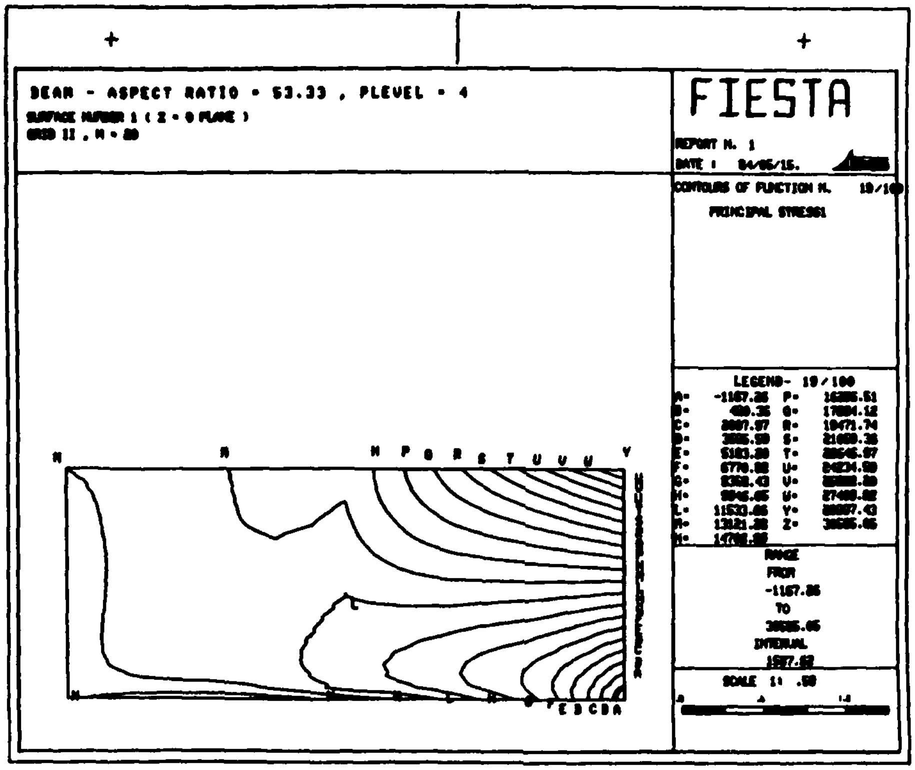

Figure G75. Annotated, X-direction principal stress contours grid II, N = 20 , P-level 4

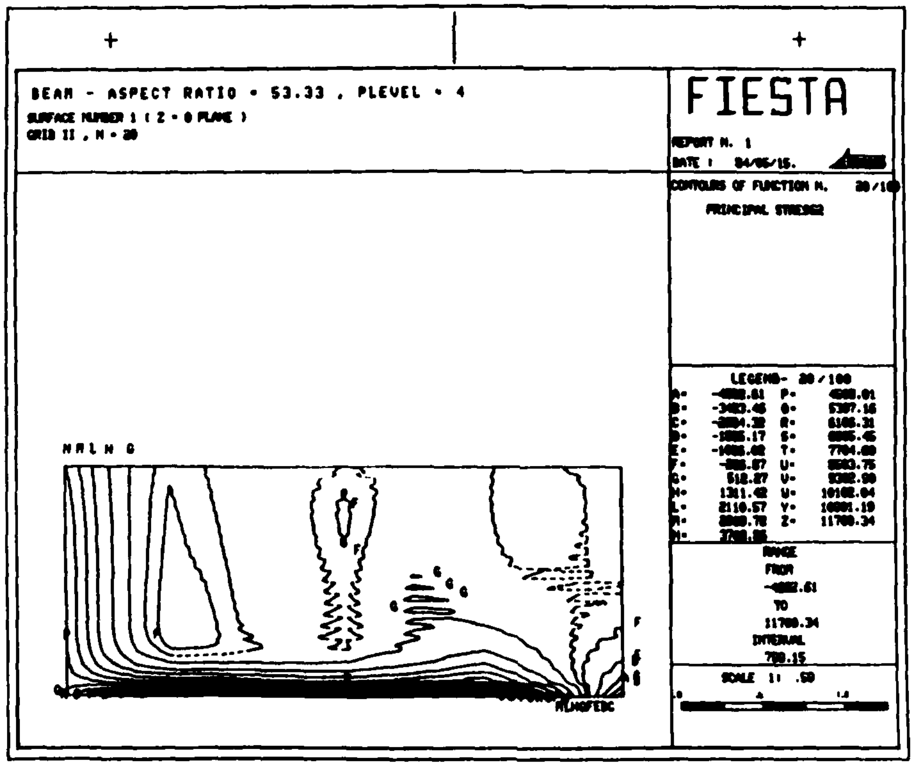

Figure G76. Annotated, Y-direction principal stress contours grid II, N = 20 , P-level 4

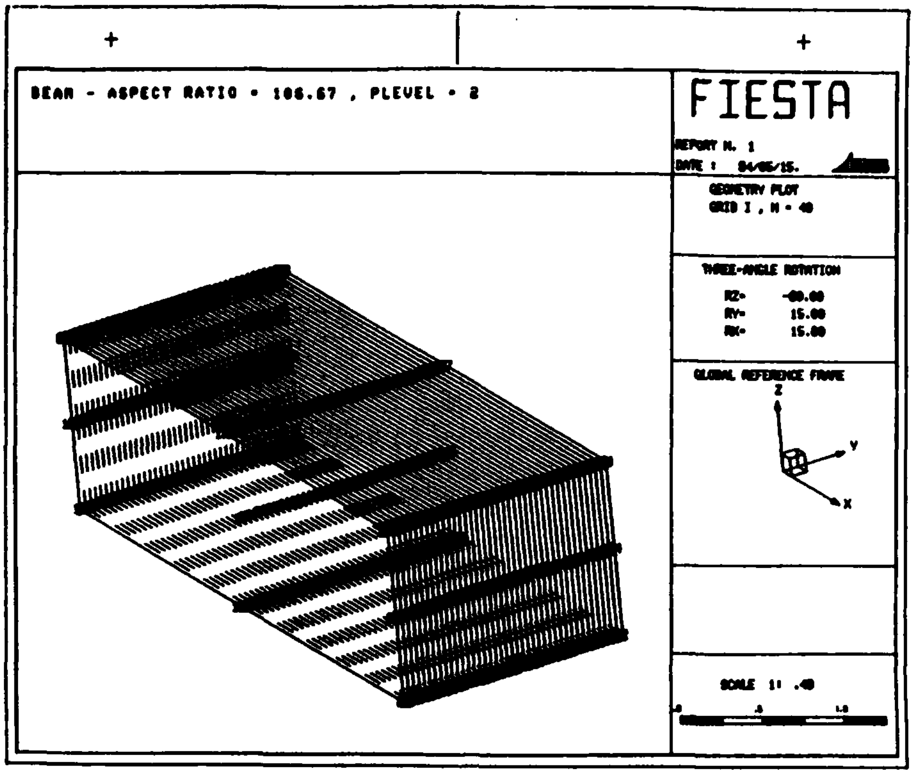

Figure G77. Annotated geometry plot
grid I, N = 40 , P-level 2

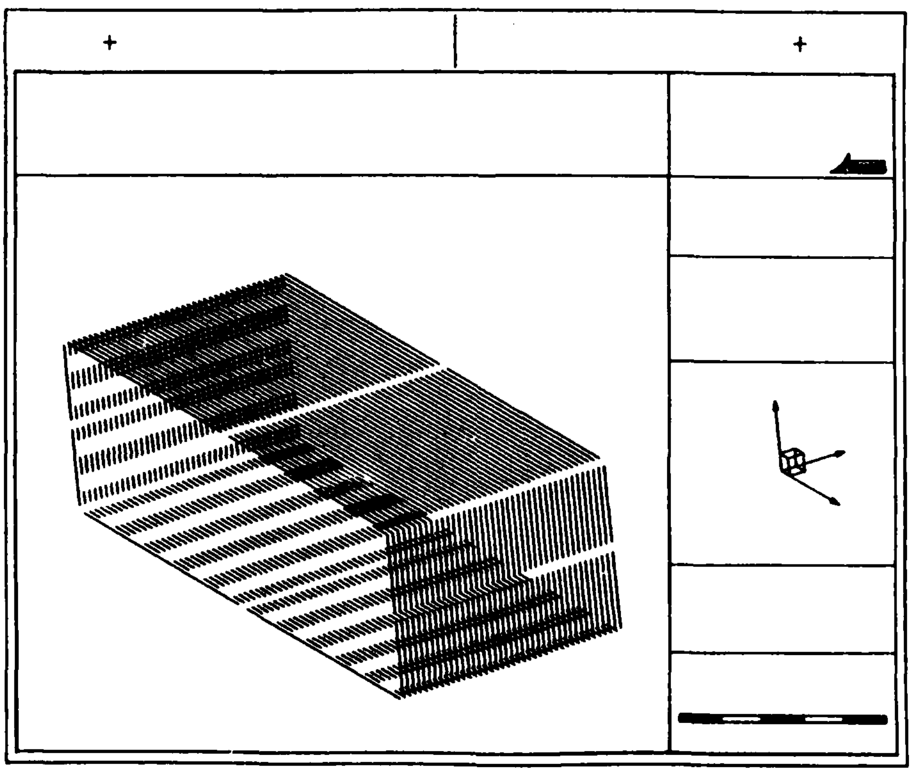

Figure G78. Nonannotated geometry plot
grid I, N = 40 , P-level 2

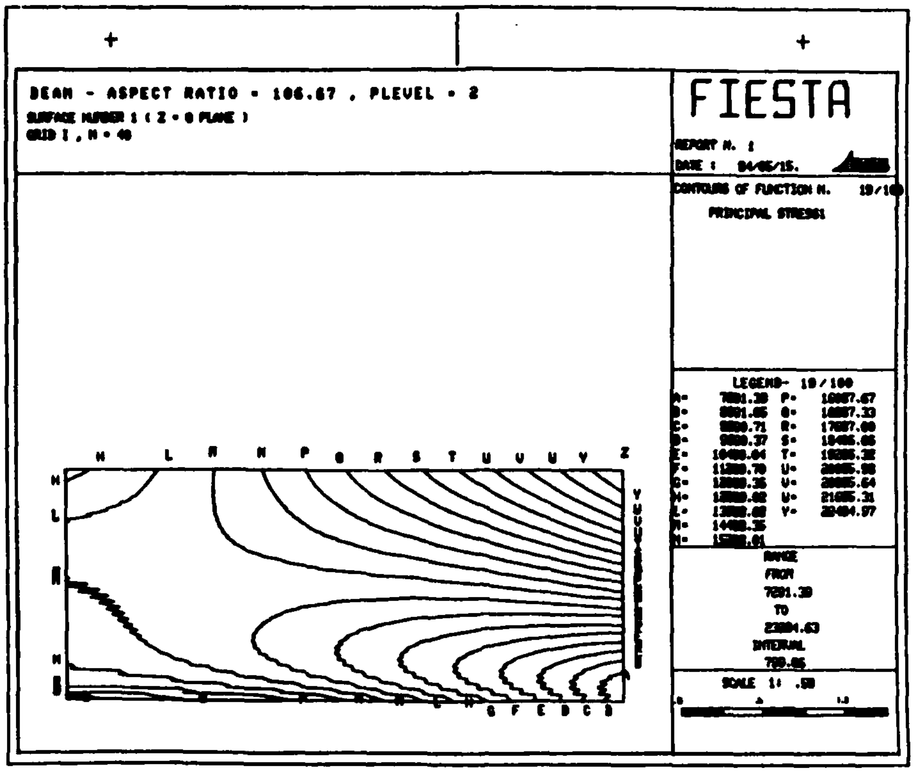

Figure G79. Annotated, X-direction principal stress contours grid I, N = 40 , P-level 2

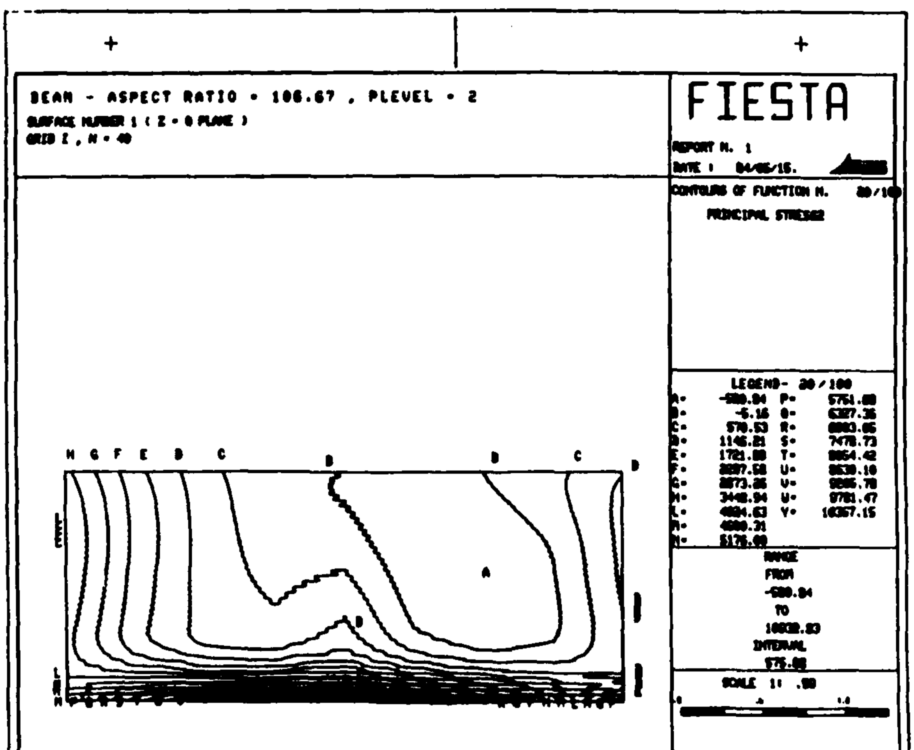

Figure G80. Annotated, Y-direction principal stress contours grid I, N = 40 , P-level 2

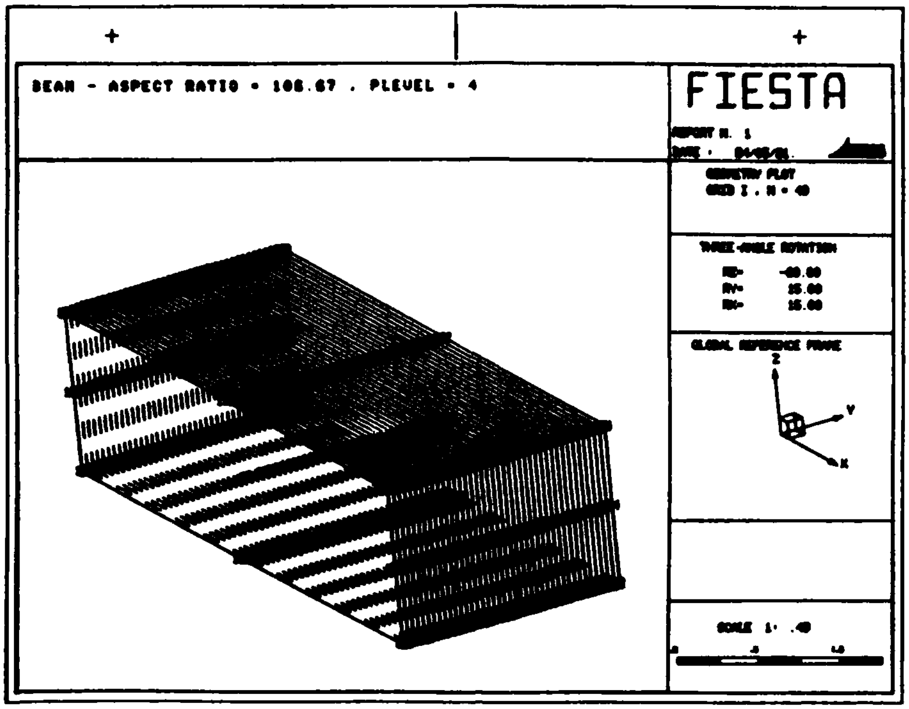

Figure G81. Annotated geometry plot
grid I, N = 40 , P-level 4

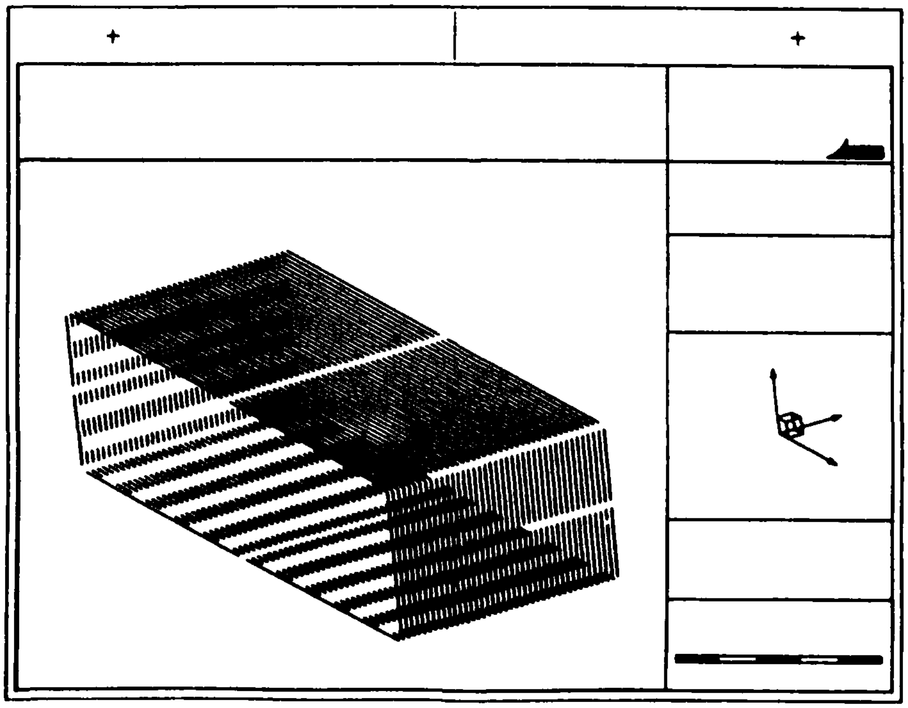

Figure G82. Nonannotated geometry plot
grid I, N = 40 , P-level 4

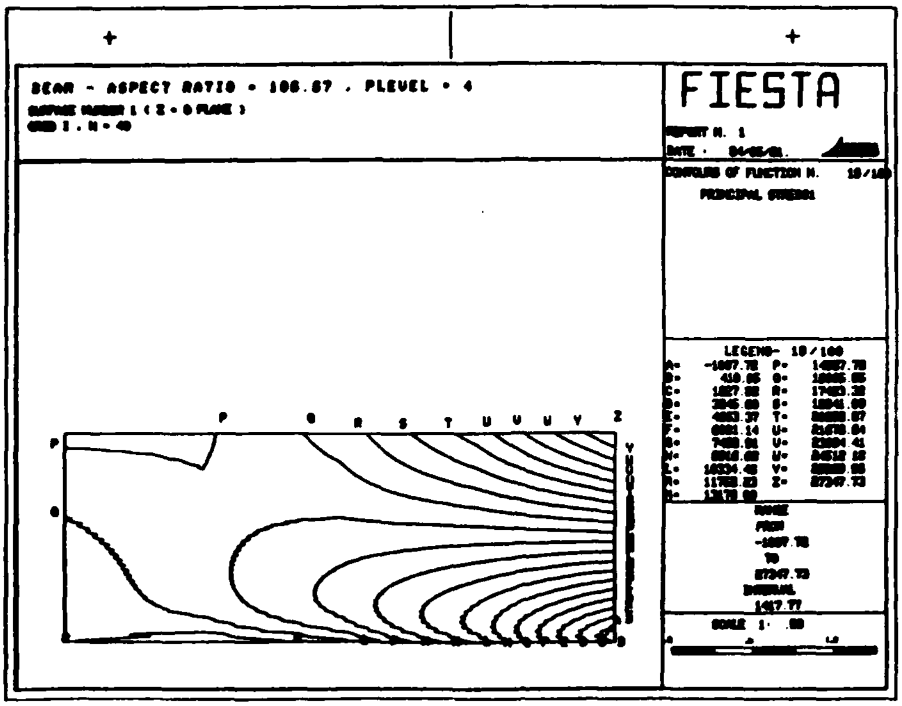

Figure G83. Annotated, X-direction principal stress contours grid I, N = 40 , P-level 4

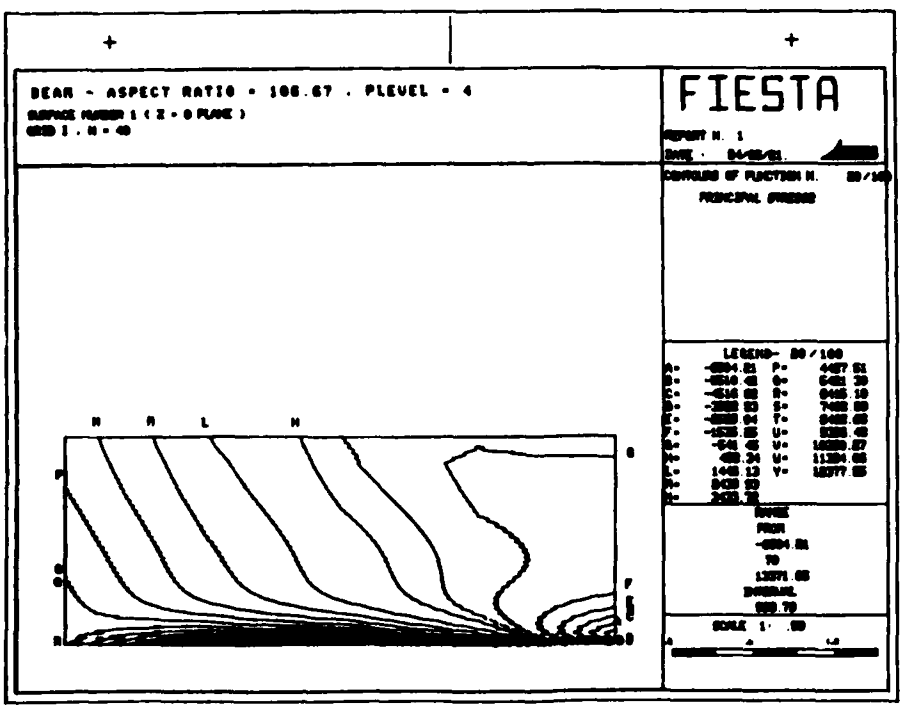

Figure G84. Annotated, Y-direction principal stress contours grid I, N = 40 , P-level 4

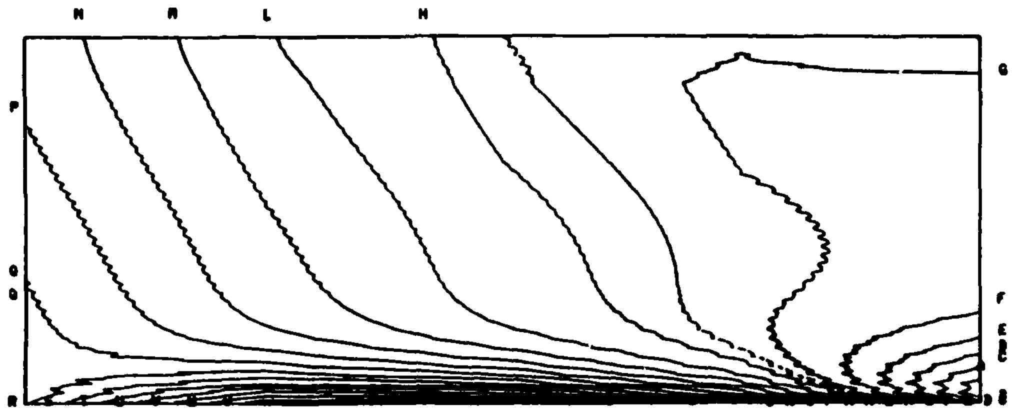

Figure G85. Annotated window of Y-direction principal stress contours grid I, N = 40 , P-level 4

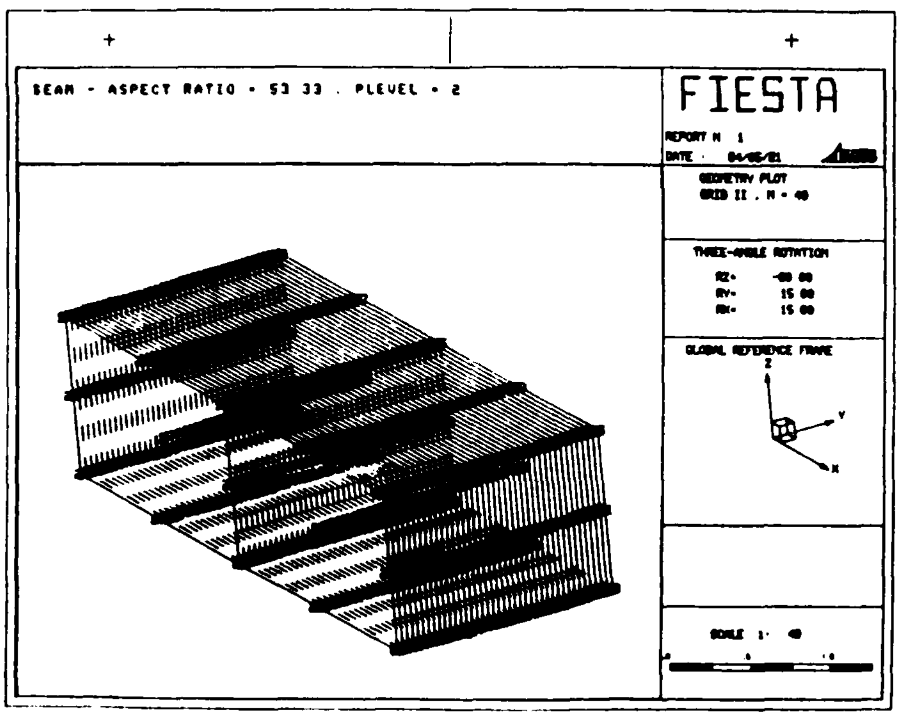

Figure G86. Annotated geometry plot grid II, N = 40 , P-level 2

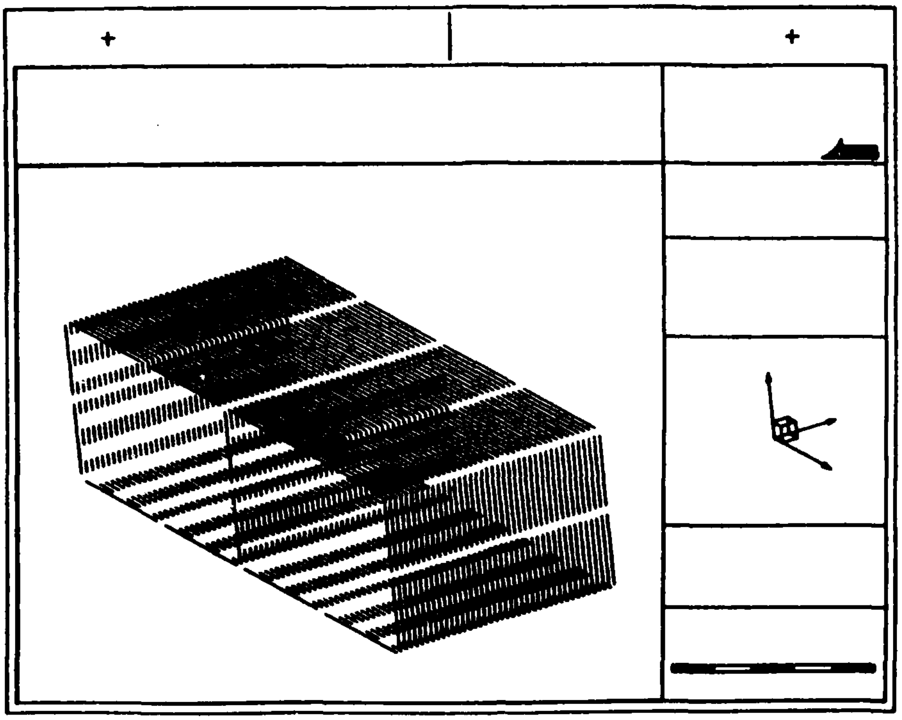

Figure G87. Nonannotated geometry plot
grid II, N = 40 , P-level 2

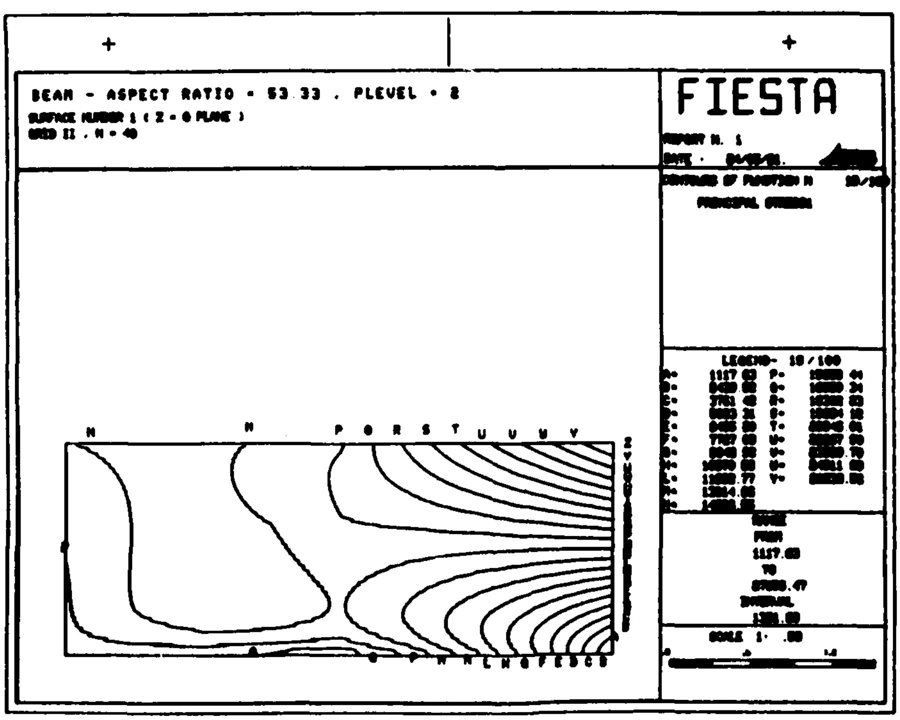

Figure G88. Annotated, X-direction principal stress contours
grid II, N = 40 , P-level 2

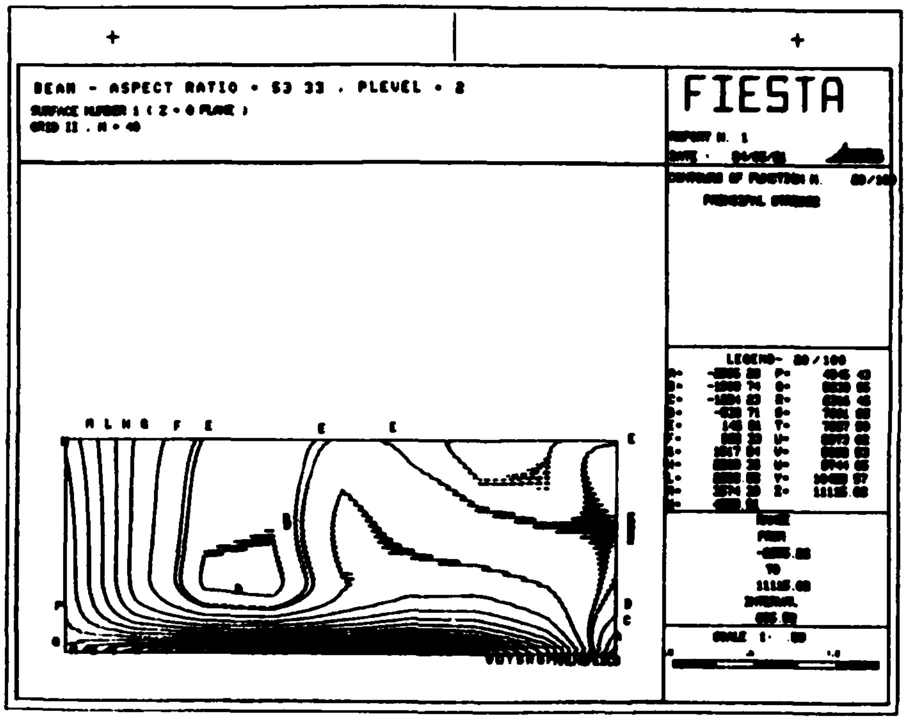

Figure G89. Annotated, Y-direction principal stress contours grid II, N = 40 , P-level 2

APPENDIX H: NODAL INPUT DATA FILES

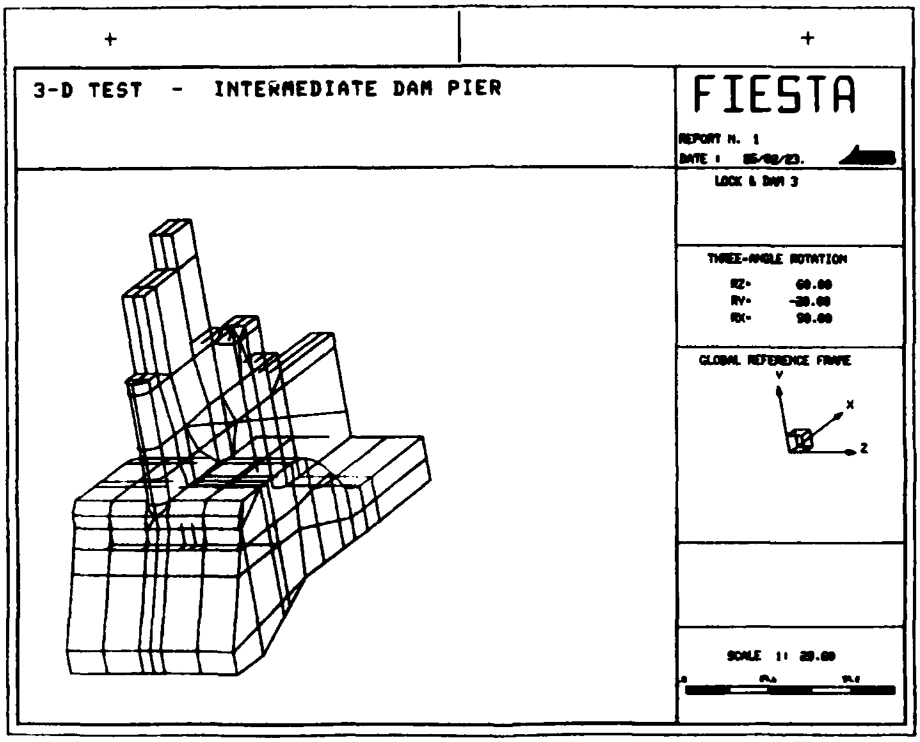

Figure H1. FIESTA 3-D study geometry plot

TSTUP8   15:11 MAR 29,'85

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00170 7 0. 0. 69.,,1 3 1
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Figure H2. FIESTA 3-D study data file P-level 2 (Sheet 1 of 6)

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02960 394 61.96 69.208 39.,,1 3 1
02970 395 61.96 76. 30.
02980 397 61.96 76. 39.,,1 3 1
02990 398 57.5 95. 30.
03000 400 57.5 95. 39.,,1 3 1
03010 401 57.5 127.42 30.
03020 403 57.5 127.42 39.,,1 3 1
03030 404 57.5 140. 30.
03040 406 57.5 140. 39.,,1 3 1
03050 407 72. 64. 30.
03060 409 72. 64. 39.,,1 3 1
03070 410 72. 66.058 30.
03080 412 72. 66.058 39.,,1 3 1
03090 413 72. 76. 30.
03100 415 72. 76. 39.,,1 3 1
03110 416 72. 95. 30.
03120 418 72. 95. 39.,,1 3 1
03130 419 72. 127.42 30.
03140 421 72. 127.42 39.,,1 3 1
03150 422 72. 140. 30.
03160 424 72. 140. 39.,,1 3 1
03170 425 78.559 64. 30.
03180 427 78.559 64. 39.,,1 3 1
03190 428 86.96 61.364 30.
03200 430 86.96 61.364 39.,,1 3 1
03210 431 86.96 64. 30.
03220 433 86.96 64. 39.,,1 3 1
03230 434 86.96 76. 30.
03240 436 86.96 76. 39.,,1 3 1
03250 437 86.96 89.452 30.
03260 439 86.96 89.452 39.,,1 3 1
03270 440 86.96 95. 30.
03280 442 86.96 95. 39.,,1 3 1
03290 443 90.702 89.452 30.
03300 445 90.702 89.452 39.,,1 3 1
03310 446 95.71 58.619 30.
03320 448 95.71 58.619 39.,,1 3 1
03330 449 95.71 64. 30.
03340 451 95.71 64. 39.,,1 3 1
03350 452 95.71 76. 30.
03360 454 95.71 76. 39.,,1 3 1
03370 455 95.71 89.452 30.
03380 457 95.71 89.452 39.,,1 3 1
03390 458 95.71 92.83 30.
03400 460 95.71 92.83 39.,,1 3 1
03410 461 105.5 55.547 30.
03420 463 105.5 55.547 39.,,1 3 1
03430 464 105.5 64. 30.
03440 466 105.5 64. 39.,,1 3 1
03450 467 105.5 76. 30.
03460 469 105.5 76. 39.,,1 3 1
03470 470 105.5 89.452 30.
03480 472 105.5 89.452 39.,,1 3 1
03490 473 105.5 92.83 30.
03500 475 106.5 92.83 39.,,1 3 1
```

Figure H2. (Sheet 2 of 6)

```
03510 476 114.5 52.723 30.
03520 478 114.5 52.723 39.,,1 3 1
03530 479 114.5 64. 30.
03540 481 114.5 64. 39.,,1 3 1
03550 482 114.5 69. 30.
03560 484 114.5 69. 39.,,1 3 1
03570 485 114.5 76. 30.
03580 487 114.5 76. 39.,,1 3 1
03590 488 154. 40.33 30.
03600 490 154. 40.33 39.,,1 3 1
03610 491 154. 64. 30.
03620 493 154. 64. 39.,,1 3 1
03630 494 154. 69. 30.
03640 496 154. 69. 39.,,1 3 1
03650 END OF COORDINATES
03660 31 1 1 29 36 8 2 30 37 9
03670 -1 6 1 3 7
03680 21 19 22 50 57 23 51 58
03690 21 20 23 51 58 24 52 59
03700 21 21 24 52 59 25 53 60
03710 21 22 25 53 60 26 54 61
03720 21 23 26 54 61 27 55 62
03730 21 24 27 55 62 28 56 63
03740 31 25 29 78 85 36 30 79 86 37
03750 -1 6 1 4 7
03760 21 49 57 71 64 58 72 65
03770 21 50 58 72 65 59 73 66
03780 12 51 73,,66,,59,,
03790     $ 330,,,
03800     $ 67
03810 12 52 61,,68,,75,,
03820     $ ,,,341
03830     $ 67
03840 21 53 61 75 68 62 76 69
03850 21 54 62 76 69 63 77 70
03860 21 55 57 106 71 58 107 72
03870 21 56 58 107 72 59 108 73
03880 21 57 59 108 73 60 109 74
03890 21 58 60 109 74 61 110 75
03900 21 59 61 110 75 62 111 76
03910 21 60 62 111 76 63 112 77
03920 31 61 78 113 120 85 79 114 121 86
03930 -1 6 1 4 7
03940 21 85 113 148 120 114 149 121
03950 21 86 114 149 121 115 150 122
03960 21 87 115 150 122 116 151 123
03970 21 88 116 151 123 117 152 124
03980 21 89 117 152 124 118 153 125
03990 21 90 118 153 125 119 154 126
04000 31 91 120 148 155 127 121 149 156 128
04010 -1 6 1 3 7
04020 31 109 148 183 190 155 149 184 191 156
04030 -1 6 1 2 7
04040 32 121 162,,197,,204,176,169,,
04050     $
04060     $ 163,,198,,205,177,170,,
04070 32 122 163,,198,,205,177,170,,
04080     $
04090     $ 164,,199,,206,178,171,,
04100 32 123 164,,199,,206,178,171,,
04110     $
04120     $ 165,,200,,207,179,172,,
04130 32 124 165,,200,,207,179,172,,
04140     $
04150     $ 166,,201,,208,180,173,,
04160 32 125 166,,201,,208,180,173,,
04170     $
04180     $ 167,,202,,209,181,174,,
04190 32 126 167,,202,,209,181,174,,
04200     $
04210     $ 168,,203,,210,182,175,,
04220 31 127 183 218 225 190 184 219 226 191
04230 -1 6 1 2 7
04240 22 139 197,,232,211,204,,
04250     $
04260     $ 198,,233,212,205,,
04270 22 140 198,,233,212,205,,
04280     $
04290     $ 199,,234,213,206,,
04300 22 141 199,,234,213,206,,
04310     $
04320     $ 200,,235,214,207,,
04330 22 142 200,,235,214,207,,
04340     $
04350     $ 201,,236,215,208,,
04360 22 143 201,,236,215,208,,
04370     $
04380     $ 202,,237,216,209,,
04390 22 144 202,,237,216,209,,
04400     $
04410     $ 203,,238,217,210,,
04420 31 145 218 239 246 225 219 240 247 226
04430 -1 6 1 2 7
04440 31 157 239 267 274 246 240 268 275 247
04450 -1 6 1
04460 32 163 246,,274,,281,260,253,,
04470     $
04480     $ 247,,275,,282,261,254,,
04490 32 164 247,,275,,282,261,254,,
04500     $
04510     $ 248,,276,,283,262,255,,
04520 32 165 248,,276,,283,262,255,,
04530     $
04540     $ 249,,277,,284,263,256,,
04550 32 166 249,,277,,284,263,256,,
04560     $
04570     $ 250,,278,,285,264,257,,
04580 32 167 250,,278,,285,264,257,,
04590     $
04600     $ 251,,279,,288,265,258,,
04610 32 168 251,,279,,288,265,258,,
04620     $
04630     $ 252,,280,,287,266,259,,
04640 31 169 267 288 246 274 268 289 296 275
04650 -1 6 1 2 7 2 21
04660 42 193 60,,74,,73,,59,,
04670     $ ,,,330,,
04680     $ 67
04690 42 194 75,,74,,60,,61,,
04700     $ 341,,,,
04710     $ 67
04720 12 195 336,,74,,67,,
04730     $ 331,,330
04740     $ 73
04750 12 196 67,,74,,336,,
04760     $ 341,,342
04770     $ 75
04780 22 197 336,,74,,73,331
04790     $
04800     $ 337,,348,,347,332
04810 22 198 336,342,75,,74,,
04820     $
04830     $ 337,343,349,,348,,
04840 22 199 337,,348,,347,332
04850     $
04860     $ 338,,351,,350,333
04870 22 200 349,,348,,337,343
04880     $
04890     $ 352,,351,,338,344
04900 22 201 338,,351,,350,333
04910     $
04920     $ 339,,354,,353,334
04930 22 202 352,,351,,338,344
04940     $
04950     $ 355,,354,,339,345
04960 22 203 339,,354,,353,334
04970     $
04980     $ 340,,357,,356,335
04990 22 204 355,,354,,339,345
05000     $
05010     $ 358,,357,,340,346
05020 31 205 73 108 359 347 74 109 360 348
05030 -1 2 1
05040 31 207 347 359 362 350 348 360 363 351
05050 -1 2 1 3 3
05060 31 213 108 143 374 359 109 144 375 360
05070 -1 2 1
05080 31 215 359 374 377 362 360 375 378 363
05090 -1 2 1 2 3
05100 21 219 365 380 368 366 381 369
05110 21 220 366 381 369 367 382 370
05120 31 221 368 380 383 371 369 381 384 372
05130 -1 2 1
05140 31 223 143 171 386 374 144 172 387 375
05150 -1 2 1
05160 21 225 171 389 386 172 390 387
05170 21 226 172 390 387 173 391 388
05180 21 227 374 386 377 375 387 378
05190 21 228 375 387 378 376 388 379
05200 31 229 376 389 392 377 387 390 393 378
05210 -1 2 1
```

Figure H2. (Sheet 3 of 6)

```
05220 21 231 377 392 395 378 393 396
05230 21 232 378 393 396 379 394 397
05240 31 233 377 395 398 380 378 396 399 381
05250 -1 2 1 2 3
05260 32 237 171,178,206,,407,,389,,
05270         $
05280       $ 172,179,207,,408,,390,,
05290 32 238 172,179,207,,408,,390,,
05300         $
05310         $ 173,180,208,,409,,391,,
05320 31 239 389 407 410 392 390 408 411 393
05330 -1 2 1 5 3
05340 21 249 206 425 407 207 426 408
05350 21 250 207 426 408 208 427 409
05360 32 251 206,213,234,,428,,425,,
05370         $
05380       $ 207,214,235,,429,,426,,
05390 32 252 207,214,235,,429,,426,,
05400         $
05410         $ 208,215,236,,430,,427,,
05420 21 253 425 428 431 426 429 432
05430 21 254 426 429 432 427 430 433
05440 21 255 407 425 410 408 426 411
05450 21 256 408 426 411 409 427 412
05460 21 257 410 425 413 411 426 414
05470 21 258 411 426 414 412 427 415
05480 31 259 425 431 434 413 426 432 435 414
05490 -1 2 1
05500 31 261 413 434 437 416 414 435 438 417
05510 -1 2 1
05520 21 263 416 437 440 417 438 441
05530 21 264 417 438 441 418 439 442
05540 31 265 234 255 446 428 235 256 447 429
05550 -1 2 1
05560 31 267 428 446 449 431 429 447 450 432
05570 -1 2 1 2 3
05580 21 271 434 443 437 435 444 438
05590 21 272 435 444 438 436 445 439
05600 21 273 434 452 443 435 453 444
05610 21 274 435 453 444 436 454 445
05620 21 275 452 455 443 453 456 444
05630 21 276 453 456 444 454 457 445
05640 21 277 437 443 440 438 444 441
05650 21 278 438 444 441 439 445 442
05660 21 279 443 455 458 444 456 459
05670 21 280 444 456 459 445 457 460
05680 32 281 255,262,283,,461,,446,,
05690         $
05700       $ 256,263,284,,462,,447,,
05710 32 282 256,263,284,,462,,447,,
05720         $
05730         $ 257,264,285,,463,,448,,
05740 31 283 446 461 464 449 447 462 465 450
05750 -1 2 1 4 3
05760 31 291 283 304 476 461 284 305 477 462
05770 -1 2 1
05780 31 293 461 476 479 464 462 477 480 465
05790 -1 2 1
05800 21 295 464 479 482 465 480 483
05810 21 296 465 480 483 466 481 484
05820 31 297 464 482 485 467 465 483 486 468
05830 -1 2 1
05840 31 299 304 325 488 476 305 326 489 477
05850 -1 2 1
05860 31 301 476 488 491 479 477 489 492 480
05870 -1 2 1 2 3
05880 END OF INCIDENCES
05890 NO LOCAL CORR. SYSTEM
05900 73 74 75 76 77 78
05910 NO EQUIVALENTING
05920 0
05930 $SURF
05940 1
05950 30.
05960 $CONST
05970 1 0 2 3
05980 1 501 2 509 3 517 4 525 5 533 6 541 7
05990 1 0 2 3
06000 497 505 513 521 529 537 545
06010 2 0 1 2 3
06020 104 108 112 116 120 124 225 229 233 237 241 245 293 296 299 302 305 $
06030 308 376 380 384 388 392 396 439 443 447 451 455 459 496 500 504 508 $
06040 512 516 540 544 548 552 556 560 584 588 592 596 600 604 628 632 636 $
06050 640 644 648
06060 3 0 3
06070 1 4
06080 END OF CONST
06090 $PROP
06100 1
06110 1 THRU 72,79 THRU 244,249 THRU 304
06120 2
06130 245 246 247 248
06140 END OF MATERIAL DISP
06150 1 0 0
06160 449568000. .17
06170 4.6584 0.
06180 2 0 0
06190 154831219. .17
06200 1.6043 0.
06210 END OF MATERIAL PROP
06220 $PLEVEL
06230 2
06240 ALL
06250 END OF PLEVEL DEF
06255 NO LIST
06340 $LOADS
06350 1
06360 TAINTER GATE,WALK,MECH. HOUSE,DEAD LOAD
06370 1
06380 437 445000. 153000. 0. 0
06390 439 1575000. 1034000. 0. 0
06400 1413 -27000. -112000. * *
06410 173 0. -20750. 0. 0
06420 175 * * * *
06430 935 * -41500. * *
06440 174 * * * *
06450 938 * * * *
06460 371 0. -33000. 0. 0
06470 383 * * * *
06480 373 * * * *
06490 385 * * * *
06500 383 0. -48187.5 0. 0
06510 385 * * * *
06520 401 * * * *
06530 403 * * * *
06540 384 * -96375. * *
06550 402 * * * *
06560 443 * -55200. * *
06570 445 * * * *
06580 444 * -43200. * *
06590 END OF POINT LOADS
```

Figure H2. (Sheet 4 of 6)

```
06600 4
06610 1 491 0.
06620 1 1661 -
06630 1 1663 -
06640 1 492 -
06650 1 488 -
06660 1 1664 -
06670 1 1666 -
06680 1 493 -
06690 1 1667 739.7
06700 1 490 1479.4
06710 1 1658 1109.3
06720 1 489 739.1
06730 1 1655 369.6
06740 1 1659 1770.9
06750 1 1656 1030.9
06760 1 1653 291.6
06770 1 327 2062.5
06780 1 1256 1692.4
06790 1 326 1322.3
06800 1 1253 952.7
06810 1 325 583.1
06820 1 145 2500.
06830 1 845 -
06840 1 146 -
06850 1 850 -
06860 1 147 -
06870 1 934 -
06880 1 937 -
06890 1 940 -
06900 1 173 562.5
06910 1 935 -
06920 1 174 -
06930 1 938 -
06940 1 175 -
06950 END OF LTYPE4
06960 8
06970 0. -32.2 0. 0
06980 ALL
06990 END OF LOAD CASE 1
07000 2
07010 HYDROSTATIC LOAD ON PIER 1/2 OPEN SIDE
07020 4
07030 1 377 0.
07040 1 1389 -
07050 1 392 -
07060 1 1429 -
07070 1 410 -
07080 1 1479 -
07090 1 425 -
07100 1 1482 -
07110 1 428 -
07120 1 1528 -
07130 1 446 -
07140 1 1582 -
07150 1 461 -
07160 1 1622 -
07170 1 476 -
07180 1 1654 -
07190 1 488 -
07200 1 1337 343.8
07210 1 374 687.5
07220 1 1329 538.8
07230 1 143 1250.
07240 1 1385 283.4
07250 1 1370 627.2
07260 1 386 566.8
07270 1 928 1069.
07280 1 1378 446.2
07290 1 1369 727.4
07300 1 1388 162.8
07310 1 389 325.5
07320 1 1377 606.8
07330 1 171 888.
07340 1 1421 227.1
07350 1 178 821.1
07360 1 1428 64.3
07370 1 407 128.6
07380 1 1420 472.9
07390 1 206 817.1
07400 1 1474 64.3
07410 1 1473 408.6
07420 1 213 928.1
07430 1 1481 589.5
07440 1 234 1179.
07450 1 1100 1366.7
07460 1 1527 777.1
07470 1 255 1554.3
07480 1 262 1566.5
07490 1 1581 767.1
07500 1 283 1534.2
07510 1 1199 1445.9
07520 1 1621 678.8
07530 1 304 1357.7
07540 1 1252 970.4
07550 1 1653 291.6
07560 1 325 583.1
07570 1 145 2500.
07580 1 934 -
07590 1 173 562.5
07600 1 1375 281.3
07610 1 388 1937.5
07620 1 1376 -
07630 1 376 -
07640 1 1335 2218.8
07650 END OF LTYPE4
07660 END OF LOAD CASE 2
07670 3
07680 HYDROSTATIC LOAD ON WEIR 1/2 OPEN SIDE
07690 4
07700 1 141 1250.
07710 1 825 -
07720 1 142 -
07730 1 830 -
07740 1 143 -
07750 1 922 1069.
07760 1 925 -
07770 1 928 -
07780 1 169 888.
07790 1 923 -
07800 1 170 -
07810 1 926 -
07820 1 171 -
07830 1 176 821.1
07840 1 177 -
07850 1 178 -
07860 1 204 817.1
07870 1 995 -
07880 1 205 -
07890 1 997 -
07900 1 206 -
07910 1 211 928.1
07920 1 212 -
07930 1 213 -
07940 1 232 1179.
07950 1 1042 -
07960 1 233 -
07970 1 1045 -
07980 1 234 -
07990 1 1094 1366.7
08000 1 1097 -
08010 1 1100 -
08020 1 253 1554.3
08030 1 1095 -
08040 1 254 -
08050 1 1098 -
08060 1 255 -
08070 1 260 1566.5
08080 1 261 -
08090 1 262 -
08100 1 281 1534.2
08110 1 1147 -
08120 1 282 -
08130 1 1149 -
08140 1 283 -
08150 1 1193 1445.9
08160 1 1196 -
08170 1 1199 -
08180 1 302 1357.7
08190 1 1194 -
08200 1 303 -
08210 1 1197 -
08220 1 304 -
08230 1 1246 970.4
08240 1 1249 -
08250 1 1252 -
08260 1 323 583.1
08270 1 1247 -
08280 1 324 -
```

Figure H2. (Sheet 5 of 6)

```
1 1250 •
1 325 •
END OF LTYPE4
END OF LOAD CASE 3
4
HYDROSTATIC LOADS
5
2 62.5 95. 2 0
3 8 13 18 23 28 34 38 40 46 50 54 59 63 67 71 75 79 85 88 91 94 97 100 0
186 187 190 191 193 194 197 198 201 202 205 206 670 673 675 677 682 684 0
208 211 219 221 270 274 286 290 707 711 714 718 0
689 692 696 699 721 725 735 739 742 746 749 753 787
2 62.5 64. 2 0
432 435 490 492 533 536 577 580 621 624 665 668 0
781 821 865 872 879 917 924 969 976 1004 1011 1032 1039
END OF LTYPE 5
END OF LOAD CASE 4
5
SOIL LOADS
1
1 161797.5 0. 0. 0
7 • • • •
2 323595. • • •
6 • • • •
3 210336.8 • • •
5 • • • •
4 97078.5 • • •
8 492480. -226102.5 • •
14 • • • •
9 984960. -452205. • •
13 • • • •
10 640224. -293933.3 • •
12 • • • •
11 295488. -135661.5 • •
15 304762.5 -200502.3 • •
21 • • • •
16 609525. -401004.6 • •
20 • • • •
17 396191.3 -260653. • •
19 • • • •
18 182857.5 -120301.4 • •
22 80257.5 -52803.9 • •
28 • • • •
23 160515. -105607.8 • •
27 • • • •
24 104334.8 -68645.1 • •
26 • • • •
25 48154.5 -31682.3 • •
57 37186.9 -15586.9 • •
63 • • • •
58 74373.8 -31173.9 • •
62 • • • •
59 48342.9 -20263. • •
61 • • • •
60 22312.1 -9352.2 • •
64 14200.3 -6075. • •
70 • • • •
65 28400.6 -12150. • •
69 • • • •
66 18460.4 -7897.5 • •
68 • • • •
67 8520.2 -3645. • •
71 1620. -2025. • •
77 • • • •
72 3240. -4050. • •
76 • • • •
73 2106. -2632.5 • •
75 • • • •
336 972. -1215. • •
END OF LTYPE 1
END OF LOAD CASE 5
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1 2 1 3 1 4 1 5 1
END OF LOAD COMB 11
END OF LOAD COMB DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$ENDP
$
```

Figure H2. (Sheet 6 of 6)

```
TSTUP3     15:11 MAR 29,'85

00110 STOP
00120 3-D TEST  -  INTERMEDIATE DAM PIER
00130 1 0. 0. 0.
00140 3 0. 0. 30.,,1 3 1
00150 4 0. 0. 34.5
00160 5 0. 0. 39.
00170 7 0. 0. 69.,,1 3 1
00180 8 0. 8.5 0.
00190 10 0. 8.5 30.,,1 3 1
00200 11 0. 8.5 34.5
00210 12 0. 8.5 39.
00220 14 0. 8.5 69.,,1 3 1
00230 15 12.368 32. 0.
00240 17 12.368 32. 30.,,1 3 1
00250 18 12.368 32. 34.5
00260 19 12.368 32. 39.
00270 21 12.368 32. 69.,,1 3 1
00280 22 16.579 40. 0.
00290 24 16.579 40. 30.,,1 3 1
00300 25 16.579 40. 34.5
00310 26 16.579 40. 39.
00320 28 16.579 40. 69.,,1 3 1
00330 29 20. 0. 0.
00340 31 20. 0. 30.,,1 3 1
00350 32 20. 0. 34.5
00360 33 20. 0. 39.
00370 35 20. 0. 69.,,1 3 1
00380 36 20. 10.761 0.
00390 38 20. 10.761 30.,,1 3 1
00400 39 20. 10.761 34.5
00410 40 20. 10.761 39.
00420 42 20. 10.761 69.,,1 3 1
00430 43 20. 32. 0.
00440 45 20. 32. 30.,, 1 3 1
00450 46 20. 32. 34.5
00460 47 20. 32. 39.
00470 49 20. 32. 69.,,1 3 1
00480 50 20. 40. 0.
00490 52 20. 40. 30.,,1 3 1
00500 53 20. 40. 34.5
00510 54 20. 40. 39.
00520 56 20. 40. 69.,,1 3 1
00530 57 20. 46.5 0.
00540 59 20. 46.5 30.,,1 3 1
00550 60 20. 46.5 34.5
00560 61 20. 46.5 39.
00570 63 20. 46.5 69.,,1 3 1
00580 64 20. 51. 0.
00590 66 20. 51. 30.,,1 3 1
00600 67 20. 51. 34.5
00610 68 20. 51. 39.
00620 70 20. 51. 69.,,1 3 1
00630 71 24.5 55. 0.
00640 73 24.5 55. 30.,,1 3 1
00650 74 24.5 55. 34.5
00660 75 24.5 55. 39.
00670 77 24.5 55. 69.,,1 3 1
00680 78 38.5 7.4 0.
00690 80 38.5 7.4 30.,,1 3 1
00700 81 38.5 7.4 34.5
00710 82 38.5 7.4 39.
00720 84 38.5 7.4 69.,,1 3 1
00730 85 38.5 12.852 0.
00740 87 38.5 12.852 30.,,1 3 1
00750 88 38.5 12.852 34.5
00760 89 38.5 12.852 39.
00770 91 38.5 12.852 69.,,1 3 1
00780 92 38.5 32. 0.
00790 94 38.5 32. 30.,,1 3 1
00800 95 38.5 32. 34.5
00810 96 38.5 32. 39.
00820 98 38.5 32. 69.,,1 3 1
00830 99 38.5 40. 0.
00840 101 38.5 40. 30.,,1 3 1
00850 102 38.5 40. 34.5
00860 103 38.5 40. 39.
00870 105 38.5 40. 69.,,1 3 1
00880 106 38.5 55. 0.
00890 108 38.5 55. 30.,,1 3 1
00900 109 38.5 55. 34.5
00910 110 38.5 55. 39.
00920 112 38.5 55. 69.,,1 3 1
00930 113 43.5 9.4 0.
00940 115 43.5 9.4 30.,,1 3 1
00950 116 43.5 9.4 34.5
00960 117 43.5 9.4 39.
00970 119 43.5 9.4 69.,,1 3 1
00980 120 43.5 13.417 0.
00990 122 43.5 13.417 30.,,1 3 1
01000 123 43.5 13.417 34.5
01010 124 43.5 13.417 39.
01020 126 43.5 13.417 69.,,1 3 1
01030 127 43.5 32. 0.
01040 129 43.5 32. 30.,,1 3 1
01050 130 43.4 32. 34.5
01060 131 43.5 32. 39.
01070 133 43.5 32. 69.,,1 3 1
01080 134 43.5 40. 0.
01090 136 43.5 40. 30.,,1 3 1
01100 137 43.5 40. 34.5
01110 138 43.5 40. 39.
01120 140 43.5 40. 69.,,1 3 1
01130 141 43.5 55. 0.
01140 143 43.5 55. 30.,,1 3 1
01150 144 43.5 55. 34.5
01160 145 43.5 55. 39.
01170 147 43.5 55. 69.,,1 3 1
01180 148 57.5 15. 0.
01190 150 57.5 15. 30.,,1 3 1
01200 151 57.5 15. 34.5
01210 152 57.5 15. 39.
01220 154 57.5 15. 69.,,1 3 1
01230 155 59.395 32. 0.
01240 157 59.395 32. 30.,,1 3 1
01250 158 59.395 32. 34.5
01260 159 59.395 32. 39.
01270 161 59.395 32. 69.,,1 3 1
01280 162 60.288 40. 0.
01290 164 60.288 40. 30.,,1 3 1
01300 165 60.288 40. 34.5
01310 166 60.288 40. 39.
01320 168 60.288 40. 69.,,1 3 1
01330 169 61.96 55. 0.
01340 171 61.96 55. 30.,,1 3 1
01350 172 61.96 55. 34.5
01360 173 61.96 55. 39.
01370 175 61.96 55. 69.,,1 3 1
01380 176 66.98 54.496 0.
01390 178 66.98 54.496 30.,,1 3 1
01400 179 66.98 54.496 34.5
01410 180 66.98 54.496 39.
01420 182 66.98 54.496 69.,,1 3 1
01430 183 72. 15. 0.
01440 185 72. 15. 30.,,1 3 1
01450 186 72. 15. 34.5
01460 187 72. 15. 39.
01470 189 72. 15. 69.,,1 3 1
01480 190 72. 28.876 0.
01490 192 72. 28.876 30.,,1 3 1
01500 193 72. 28.876 34.5
01510 194 72. 28.876 39.
01520 196 72. 28.876 69.,,1 3 1
01530 197 72. 41.25 0.
01540 199 72. 41.25 30.,,1 3 1
01550 200 72. 41.25 34.5
01560 201 72. 41.25 39.
01570 203 72. 41.25 69.,,1 3 1
01580 204 72. 52.984 0.
01590 206 72. 52.984 30.,,1 3 1
01600 207 72. 52.984 34.5
01610 208 72. 52.984 39.
01620 210 72. 52.984 69.,,1 3 1
01630 211 79.48 48.861 0.
01640 213 79.48 48.861 30.,,1 3 1
01650 214 79.48 48.861 34.5
01660 215 79.48 48.861 39.
01670 217 79.48 48.861 69.,,1 3 1
01680 218 86.96 15. 0.
01690 220 86.96 15. 30.,,1 3 1
01700 221 86.96 15. 34.5
01710 222 86.96 15. 39.
01720 224 86.96 15. 69.,,1 3 1
01730 225 86.96 25.169 0.
01740 227 86.96 25.169 30.,,1 3 1
01750 228 86.96 25.169 34.5
01760 229 86.96 25.169 39.
01770 231 86.96 25.169 69.,,1 3 1
01780 232 86.96 42.5 0.
01790 234 86.96 42.5 30.,,1 3 1
```

Figure H3. FIESTA 3-D study data file P-level 3 (Sheet 1 of 6)

```
01800 235 86.96 42.5 34.5
01810 236 86.96 42.5 39.
01820 238 86.96 42.5 69.,,1 3 1
01830 239 95.71 15. 0.
01840 241 95.71 15. 30.,,1 3 1
01850 242 95.71 15. 34.5
01860 243 95.71 15. 39.
01870 245 95.71 15. 69.,,1 3 1
01880 246 95.71 23. 0.
01890 248 95.71 23. 30.,,1 3 1
01900 249 95.71 23. 34.5
01910 250 95.71 23. 39.
01920 252 95.71 23. 69.,,1 3 1
01930 253 95.71 33.75 0.
01940 255 95.71 33.75 30.,,1 3 1
01950 256 95.71 33.75 34.5
01960 257 95.71 33.75 39.
01970 259 95.71 33.75 69.,,1 3 1
01980 260 100.416 32.077 0.
01990 262 100.416 32.077 30.,,1 3 1
02000 263 100.416 32.077 34.5
02010 264 100.416 32.077 39.
02020 266 100.416 32.077 69.,,1 3 1
02030 267 105.5 15. 0.
02040 269 105.5 15. 30.,,1 3 1
02050 270 105.5 15. 34.5
02060 271 105.5 15. 39.
02070 273 105.5 15. 69.,,1 3 1
02080 274 105.5 23. 0.
02090 276 105.5 23. 30.,,1 3 1
02100 277 105.5 23. 34.5
02110 278 105.5 23. 39.
02120 280 105.5 23. 69.,,1 3 1
02130 281 105.5 31. 0.
02140 283 105.5 31. 30.,,1 3 1
02150 284 105.5 31. 34.5
02160 285 105.5 31. 39.
02170 287 105.5 31. 69.,,1 3 1
02180 288 114.5 15. 0.
02190 290 114.5 15. 30.,,1 3 1
02200 291 114.5 15. 34.5
02210 292 114.5 15. 39.
02220 294 114.5 15. 69.,,1 3 1
02230 295 114.5 23. 0.
02240 297 114.5 23. 30.,,1 3 1
02250 298 114.5 23. 34.5
02260 299 114.5 23. 39.
02270 301 114.5 23. 69.,,1 3 1
02280 302 114.5 31. 0.
02290 304 114.5 31. 30.,,1 3 1
02300 305 114.5 31. 34.5
02310 306 114.5 31. 39.
02320 308 114.5 31. 69.,,1 3 1
02330 309 154. 15. 0.
02340 311 154. 15. 30.,,1 3 1
02350 312 154. 15. 34.5
02360 313 154. 15. 39.
02370 315 154. 15. 69.,,1 3 1
02380 316 154. 23. 0.
02390 318 154. 23. 30.,,1 3 1
02400 319 154. 23. 34.5
02410 320 154. 23. 39.
02420 322 154. 23. 69.,,1 3 1
02430 323 154. 31. 0.
02440 325 154. 31. 30.,,1 3 1
02450 326 154. 31. 34.5
02460 327 154. 31. 39.
02470 329 154. 31. 69.,,1 3 1
02480 330 21.318 52.75 31.318
02490 331 21.318 55. 31.318
02500 332 21.318 64. 31.318
02510 333 21.318 75. 31.318
02520 334 21.318 95. 31.318
02530 335 21.318 99. 31.318
02540 336 20. 55. 34.5
02550 337 20. 64. 34.5
02560 338 20. 75. 34.5
02570 339 20. 95. 34.5
02580 340 20. 99. 34.5
02590 341 21.318 52.75 37.682
02600 342 21.318 55. 37.682
02610 343 21.318 64. 37.682
02620 344 21.318 75. 37.682
02630 345 21.318 95. 37.682
02640 346 21.318 99. 37.682
02650 347 24.5 64. 30.
02660 349 24.5 64. 39.,,1 3 1
02670 350 24.5 75. 30.
02680 352 24.5 75. 39.,,1 3 1
02690 353 24.5 95. 30.
02700 355 24.5 95. 39.,,1 3 1
02710 356 24.5 99. 30.
02720 358 24.5 99. 39.,,1 3 1
02730 359 35.5 64. 30.
02740 361 35.5 64. 39.,,1 3 1
02750 362 35.5 75. 30.
02760 364 35.5 75. 39.,,1 3 1
02770 365 31. 95. 30.
02780 367 31. 95. 39.,,1 3 1
02790 368 31. 99. 30.
02800 370 31. 99. 39.,,1 3 1
02810 371 31. 127.42 30.
02820 373 31. 127.42 39.,,1 3 1
02830 374 43.5 64. 30.
02840 376 43.5 64. 39.,,1 3 1
02850 377 43.5 75. 30.
02860 379 43.5 75. 39.,,1 3 1
02870 380 40. 95. 30.
02880 382 40. 95. 39.,,1 3 1
02890 383 40. 127.42 30.
02900 385 40. 127.42 39.,,1 3 1
02910 386 49.653 64. 30.
02920 388 49.653 64. 39.,,1 3 1
02930 389 61.96 64. 30.
02940 391 61.96 64. 39.,,1 3 1
02950 392 61.96 69.208 30.
02960 394 61.96 69.208 39.,,1 3 1
02970 395 61.96 76. 30.
02980 397 61.96 76. 39.,,1 3 1
02990 398 57.5 95. 30.
03000 400 57.5 95. 39.,,1 3 1
03010 401 57.5 127.42 30.
03020 403 57.5 127.42 39.,,1 3 1
03030 404 57.5 140. 30.
03040 406 57.5 140. 39.,,1 3 1
03050 407 72. 64. 30.
03060 409 72. 64. 39.,,1 3 1
03070 410 72. 66.058 30.
03080 412 72. 66.058 39.,,1 3 1
03090 413 72. 76. 30.
03100 415 72. 76. 39.,,1 3 1
03110 416 72. 95. 30.
03120 418 72. 95. 39.,,1 3 1
03130 419 72. 127.42 30.
03140 421 72. 127.42 39.,,1 3 1
03150 422 72. 140. 30.
03160 424 72. 140. 39.,,1 3 1
03170 425 78.559 64. 30.
03180 427 78.559 64. 39.,,1 3 1
03190 428 86.96 61.364 30.
03200 430 86.96 61.364 39.,,1 3 1
03210 431 86.96 64. 30.
03220 433 86.96 64. 39.,,1 3 1
03230 434 86.96 76. 30.
03240 436 86.96 76. 39.,,1 3 1
03250 437 86.96 89.452 30.
03260 439 86.96 89.452 39.,,1 3 1
03270 440 86.96 95. 30.
03280 442 86.96 95. 39.,,1 3 1
03290 443 90.702 89.452 30.
03300 445 90.702 89.452 39.,,1 3 1
03310 446 95.71 58.619 30.
03320 448 95.71 58.619 39.,,1 3 1
03330 449 95.71 64. 30.
03340 451 95.71 64. 39.,,1 3 1
03350 452 95.71 76. 30.
03360 454 95.71 76. 39.,,1 3 1
03370 455 95.71 89.452 30.
03380 457 95.71 89.452 39.,,1 3 1
03390 458 95.71 92.83 30.
03400 460 95.71 92.83 39.,,1 3 1
03410 461 105.5 55.547 30.
03420 463 105.5 55.547 39.,,1 3 1
03430 464 105.5 64. 30.
03440 466 105.5 64. 39.,,1 3 1
03450 467 105.5 76. 30.
03460 469 105.5 76. 39.,,1 3 1
03470 470 105.5 89.452 30.
03480 472 105.5 89.452 39.,,1 3 1
03490 473 105.5 92.83 30.
```

Figure H3. (Sheet 2 of 6)

```
03500 475 106.5 92.83 39.,,1 3 1
03510 476 114.5 52.723 30.
03520 478 114.5 52.723 39.,,1 3 1
03530 479 114.5 64. 30.
03540 481 114.5 64. 39.,,1 3 1
03550 482 114.5 69. 30.
03560 484 114.5 69. 39.,,1 3 1
03570 485 114.5 76. 30.
03580 487 114.5 76. 39.,,1 3 1
03590 488 154. 40.33 30.
03600 490 154. 40.33 39.,,1 3 1
03610 491 154. 64. 30.
03620 493 154. 64. 39.,,1 3 1
03630 494 154. 69. 30.
03640 496 154. 69. 39.,,1 3 1
03650 END OF COORDINATES
03660 31 1 1 29 36 8 2 30 37 9
03670 -1 6 1 3 7
03680 21 19 22 50 57 23 51 58
03690 21 20 23 51 58 24 52 59
03700 21 21 24 52 59 25 53 60
03710 21 22 25 53 60 26 54 61
03720 21 23 26 54 61 27 55 62
03730 21 24 27 55 62 28 56 63
03740 31 25 29 78 85 36 30 79 86 37
03750 -1 6 1 4 7
03760 21 49 57 71 64 58 72 65
03770 21 50 58 72 65 59 73 66
03780 12 51 73,,66,,59,,
03790     $ 330,,,
03800     $ 67
03810 12 52 61,,68,,75,,
03820     $ ,,,341
03830     $ 67
03840 21 53 61 75 68 62 76 69
03850 21 54 62 76 69 63 77 70
03860 21 55 57 106 71 58 107 72
03870 21 56 58 107 72 59 108 73
03880 21 57 59 108 73 60 109 74
03890 21 58 60 109 74 61 110 75
03900 21 59 61 110 75 62 111 76
03910 21 60 62 111 76 63 112 77
03920 31 61 78 113 120 85 79 114 121 86
03930 -1 6 1 4 7
03940 21 85 113 148 120 114 149 121
03950 21 86 114 149 121 115 150 122
03960 21 87 115 150 122 116 151 123
03970 21 88 116 151 123 117 152 124
03980 21 89 117 152 124 118 153 125
03990 21 90 118 153 125 119 154 126
04000 31 91 120 148 155 127 121 149 156 128
04010 -1 6 1 3 7
04020 31 109 148 183 190 155 149 184 191 156
04030 -1 6 1 2 7
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04050        $
04060        $ 163,,198,,205,177,170,,
04070 32 122 163,,198,,206,177,170,,
04080        $
04090        $ 164,,199,,206,178,171,,
04100 32 123 164,,199,,206,178,171,,
04110        $
04120        $ 165,,200,,207,179,172,,
04130 32 124 165,,200,,207,179,172,,
04140        $
04150        $ 166,,201,,208,180,173,,
04160 32 125 166,,201,,208,180,173,,
04170        $
04180        $ 167,,202,,209,181,174,,
04190 32 126 167,,202,,209,181,174,,
04200        $
04210        $ 168,,203,,210,182,175,,
04220 31 127 183 218 225 190 184 219 226 191
04230 -1 6 1 2 7
04240 22 139 197,,232,211,204,,
04250    $
04260    $ 198,,233,212,205,,
04270 22 140 198,,233,212,205,,
04280    $
04290    $ 199,,234,213,206,,
04300 22 141 199,,234,213,206,,
04310    $
04320    $ 200,,235,214,207,,
04330 22 142 200,,235,214,207,,
04340    $
04350    $ 201,,236,215,208,,
04360 22 143 201,,236,215,208,,
04370    $
04380    $ 202,,237,216,209,,
04390 22 144 202,,237,216,209,,
04400    $
04410    $ 203,,238,217,210,,
04420 31 145 218 239 246 225 219 240 247 226
04430 -1 6 1 2 7
04440 31 157 239 267 274 246 240 268 275 247
04450 -1 6 1
04460 32 163 246,,274,,281,260,253,,
04470        $
04480        $ 247,,275,,282,261,254,,
04490 32 164 247,,275,,282,261,254,,
04500        $
04510        $ 248,,276,,283,262,255,,
04520 32 165 248,,276,,283,262,255,,
04530        $
04540        $ 249,,277,,284,263,256,,
04550 32 166 249,,277,,284,263,256,,
04560        $
04570        $ 250,,278,,285,264,257,,
04580 32 167 250,,278,,285,264,257,,
04590        $
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04610 32 168 251,,279,,286,265,258,,
04620        $
04630        $ 252,,280,,287,266,259,,
04640 31 169 267 288 295 274 268 289 296 275
04650 -1 6 1 2 7 2 21
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04670    $ ,,,330,,
04680    $ 67
04690 42 194 75,,74,,60,,61,,
04700    $ 341,,,,
04710    $ 67
04720 12 195 336,,74,,67,,
04730    $ 331,,330
04740     $ 73
04750 12 196 67,,74,,336,,
04760    $ 341,,342
04770    $ 75
04780 22 197 336,,74,,73,331
04790    $
04800    $ 337,,348,,347,332
04810 22 198 336,342,75,,74,,
04820    $
04830    $ 337,343,349,,348,,
04840 22 199 337,,348,,347,332
04850    $
04860    $ 338,,351,,350,333
04870 22 200 349,,348,,337,343
04880    $
04890    $ 352,,351,,338,344
04900 22 201 338,,351,,350,333
04910    $
04920    $ 339,,354,,353,334
04930 22 202 352,,351,,338,344
04940    $
04950   $ 355,,354,,339,345
04960 22 203 339,,354,,353,334
04970    $
04980    $ 340,,357,,356,335
04990 22 204 355,,354,,339,345
05000    $
05010    $ 358,,357,,340,346
05020 31 205 73 108 359 347 74 109 360 348
05030 -1 2 1
05040 31 207 347 359 362 350 348 360 363 351
05050 -1 2 1 3 3
05060 31 213 108 143 374 359 109 144 375 360
05070 -1 2 1
05080 31 215 359 374 377 362 360 375 378 363
05090 -1 2 1 2 3
05100 21 219 365 380 368 366 381 369
05110 21 220 366 381 369 367 382 370
05120 31 221 368 380 383 371 369 381 384 372
05130 -1 2 1
05140 31 223 143 171 386 374 144 172 387 375
05150 -1 2 1
05160 21 225 171 389 386 172 390 387
05170 21 226 172 390 387 173 391 388
05180 21 227 374 386 377 375 387 378
05190 21 228 375 387 378 376 388 379
05200 31 229 386 389 392 377 387 390 393 378
05210 -1 2 1
```

Figure H3. (Sheet 3 of 6)

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05220 21 231 377 392 395 378 393 396
05230 21 232 378 393 396 379 394 397
05240 31 233 377 395 398 380 378 396 399 381
05250 -1 2 1 2 3
05260 32 237 171,178,206,,407,,389,,
05270       $
05280     $ 172,179,207,,408,,390,,
05290 32 238 172,179,207,,408,,390,,
05300       $
05310       $ 173,180,208,,409,,391,,
05320 31 239 389 407 410 392 390 408 411 393
05330 -1 2 1 5 3
05340 21 249 206 425 407 207 426 408
05350 21 250 207 426 408 208 427 409
05360 32 251 206,213,234,,428,,425,,
05370       $
05380     $ 207,214,235,,429,,426,,
05390 32 252 207,214,235,,429,,426,,
05400       $
05410       $ 208,215,236,,430,,427,,
05420 21 253 425 428 431 426 429 432
05430 21 254 426 429 432 427 430 433
05440 21 255 407 425 410 408 426 411
05450 21 256 408 426 411 409 427 412
05460 21 257 410 425 413 411 426 414
05470 21 258 411 426 414 412 427 415
05480 31 259 425 431 434 413 426 432 435 414
05490 -1 2 1
05500 31 261 413 434 437 416 414 435 438 417
05510 -1 2 1
05520 21 263 416 437 440 417 438 441
05530 21 264 417 438 441 418 439 442
05540 31 265 234 255 446 428 235 256 447 429
05550 -1 2 1
05560 31 267 428 446 449 431 429 447 450 432
05570 -1 2 1 2 3
05580 21 271 434 443 437 435 444 438
05590 21 272 435 444 438 436 445 439
05600 21 273 434 452 443 435 453 444
05610 21 274 435 453 444 436 454 445
05620 21 275 452 455 443 453 456 444
05630 21 276 453 456 444 454 457 445
05640 21 277 437 443 440 438 444 441
05650 21 278 438 444 441 439 445 442
05660 21 279 443 455 458 444 456 459
05670 21 280 444 456 459 445 457 460
05680 32 281 255,262,283,,461,,446,,
05690       $
05700     $ 256,263,284,,462,,447,,
05710 32 282 256,263,284,,462,,447,,
05720       $
05730       $ 257,264,285,,463,,448,,
05740 31 283 446 461 464 449 447 462 465 450
05750 -1 2 1 4 3
05760 31 291 283 304 476 461 284 305 477 462
05770 -1 2 1
05780 31 293 461 476 479 464 462 477 480 465
05790 -1 2 1
05800 21 295 464 479 482 465 480 483
05810 21 296 465 480 483 466 481 484
05820 31 297 464 482 485 467 465 483 486 468
05830 -1 2 1
05840 31 299 304 325 488 476 305 326 489 477
05850 -1 2 1
05860 31 301 476 488 491 479 477 489 492 480
05870 -1 2 1 2 3
05880 END OF INCIDENCES
05890 NO LOCAL CORR. SYSTEM
05900 73 74 75 76 77 78
05910 NO EQUIVALENTING
05920 0
05930 $SURF
05940 1
05950 30.
05960 $CONST
05970 1 0 2 3
05980 1 501 2 509 3 517 4 525 5 533 6 541 7
05990 1 0 2 3
06000 497 505 513 521 529 537 545
06010 2 0 1 2 3
06020 104 108 112 116 120 124 225 229 233 237 241 245 293 296 299 302 305 $
06030 308 376 380 384 388 392 396 439 443 447 451 455 459 456 500 504 508 $
06040 512 516 540 544 548 552 556 560 584 588 592 596 600 604 628 632 636 $
06050 640 644 648
06060 3 0 3
06070 1 4
06080 END OF CONST
06090 $PROP
06100 1
06110 1 THRU 72,79 THRU 244,249 THRU 304
06120 2
06130 245 246 247 248
06140 END OF MATERIAL DISP
06150 1 0 0
06160 449568000. .17
06170 4.6584 0.
06180 2 0 0
06190 154831219. .17
06200 1.6043 0.
06210 END OF MATERIAL PROP
06220 $PLEVEL
06230 3
06240 ALL
06250 END OF PLEVEL DEF
06255 NO LIST
06340 $LOADS
06350 1
06360 TAINTER GATE,WALK,MECH. HOUSE,DEAD LOAD
06370 1
06380 437 445000. 153000. 0. 0
06390 439 1575000. 1034000. 0. 0
06400 1413 -27000. -112000. * *
06410 173 0. -20750. 0. 0
06420 175 * * * *
06430 935 * -41500. * *
06440 174 * * * *
06450 938 * * * *
06460 371 0. -33000. 0. 0
06470 383 * * * *
06480 373 * * * *
06490 385 * * * *
06500 383 0. -48187.5 0. 0
06510 385 * * * *
06520 401 * * * *
06530 403 * * * *
06540 384 * -96375. * *
06550 402 * * * *
06560 443 * -55200. * *
06570 445 * * * *
06580 444 * -43200. * *
06590 END OF POINT LOADS
```

Figure H3. (Sheet 4 of 6)

```
06600 4
06610 1 491 0.
06620 1 1661 .
06630 1 1663 .
06640 1 492 .
06650 1 488 .
06660 1 1664 .
06670 1 1666 .
06680 1 493 .
06690 1 1667 739.7
06700 1 490 1479.4
06710 1 1658 1109.3
06720 1 489 739.1
06730 1 1655 369.6
06740 1 1659 1770.9
06750 1 1656 1030.9
06760 1 1653 291.6
06770 1 327 2062.5
06780 1 1256 1692.4
06790 1 326 1322.3
06800 1 1253 952.7
06810 1 325 583.1
06820 1 145 2500.
06830 1 845 .
06840 1 146 .
06850 1 850 .
06860 1 147 .
06870 1 934 .
06880 1 937 .
06890 1 940 .
06900 1 173 562.5
06910 1 935 .
06920 1 174 .
06930 1 938 .
06940 1 175 .
06950 END OF LTYPE4
06960 8
06970 0. -32.2 0. 0
06980 ALL
06990 END OF LOAD CASE 1
06700 1 490 1479.4
06710 1 1658 1109.3
06720 1 489 739.1
06730 1 1655 369.6
06740 1 1659 1770.9
06750 1 1656 1030.9
06760 1 1653 291.6
06770 1 327 2062.5
06780 1 1256 1692.4
06790 1 326 1322.3
06800 1 1253 952.7
06810 1 325 583.1
06820 1 145 2500.
06830 1 845 .
06840 1 146 .
06850 1 850 .
06860 1 147 .
06870 1 934 .
06880 1 937 .
06890 1 940 .
06900 1 173 562.5
06910 1 935 .
06920 1 174 .
06930 1 938 .
06940 1 175 .
06950 END OF LTYPE4
06960 8
06970 0. -32.2 0. 0
06980 ALL
06990 END OF LOAD CASE 1
07000 2
07010 HYDROSTATIC LOAD ON PIER 1/2 OPEN SIDE
07020 4
07030 1 377 0.
07040 1 1389 .
07050 1 392 .
07060 1 1429 .
07070 1 410 .
07080 1 1479 .
07090 1 425 .
07100 1 1482 .
07110 1 428 .
07120 1 1528 .
07130 1 446 .
07140 1 1582 .
07150 1 461 .
07160 1 1622 .
07170 1 476 .
07180 1 1654 .
07190 1 488 .
07200 1 1337 343.8
07210 1 374 687.5
07220 1 1329 968.8
07230 1 143 1250.
07240 1 1385 283.4
07250 1 1370 627.2
07260 1 386 566.8
07270 1 928 1069.
07280 1 1378 446.2
07290 1 1369 727.4
07300 1 1388 162.8
07310 1 389 325.5
07320 1 1377 606.8
07330 1 171 888.
07340 1 1421 227.1
07350 1 178 821.1
07360 1 1428 64.3
07370 1 407 128.6
07380 1 1420 472.9
07390 1 206 817.1
07400 1 1474 64.3
07410 1 1473 408.6
07420 1 213 928.1
07430 1 1481 589.5
07440 1 234 1179.
07450 1 1100 1366.7
07460 1 1527 777.1
07470 1 255 1554.3
07480 1 262 1566.5
07490 1 1581 767.1
07500 1 283 1534.2
07510 1 1199 1445.9
07520 1 1621 678.8
07530 1 304 1357.7
07540 1 1252 970.4
07550 1 1653 291.6
07560 1 325 583.1
07570 1 145 2500.
07580 1 934 .
07590 1 173 562.5
07600 1 1375 281.3
07610 1 383 1937.5
07620 1 1376 .
07630 1 376 .
07640 1 1335 2218.8
07650 END OF LTYPE4
07660 END OF LOAD CASE 2
07670 3
07680 HYDROSTATIC LOAD ON WEIR 1/2 OPEN SIDE
07690 4
07700 1 141 1250.
07710 1 825 .
07720 1 142 .
07730 1 830 .
07740 1 143 .
07750 1 922 1069.
07760 1 925 .
07770 1 928 .
07780 1 169 888.
07790 1 923 .
07800 1 170 .
07810 1 926 .
07820 1 171 .
07830 1 176 821.1
07840 1 177 .
07850 1 178 .
07860 1 204 817.1
07870 1 995 .
07880 1 205 .
07890 1 997 .
07900 1 206 .
07910 1 211 928.1
07920 1 212 .
07930 1 213 .
07940 1 232 1179.
07950 1 1042 .
07960 1 233 .
07970 1 1045 .
07980 1 234 .
07990 1 1094 1366.7
```

Figure H3. (Sheet 5 of 6)

```
1 1097 •
1 1100 •
1 253 1554.3
1 1095 •
1 254 •
1 1098 •
1 255 •
1 260 1566.5
1 261 •
1 262 •
1 281 1534.2
1 1147 •
1 282 •
1 1149 •
1 283 •
1 1193 1445.9
1 1196 •
1 1190 •
1 302 1357.7
1 1194 •
1 303 •
1 1197 •
1 304 •
1 1246 970.4
1 1249 •
1 1252 •
1 323 583.1
1 1247 •
1 324 •
1 1250 •
1 325 •
END OF LTYPE4
END OF LOAD CASE 3
4
HYDROSTATIC LOADS
5
2 62.5 95. 2 0
3 8 13 18 23 28 34 38 42 46 50 54 59 63 67 71 75 79 85 88 91 94 97 100 $
186 187 190 191 193 194 197 198 201 202 205 206 670 673 675 677 682 684 $
209 211 219 221 270 274 285 290 707 711 714 718 $
689 692 696 699 721 725 736 739 742 746 749 753 787
2 62.5 64. 2 0
432 435 490 492 533 536 577 580 621 624 665 668 $
781 821 865 872 879 917 924 969 976 1004 1011 1032 1039
END OF LTYPE 5
END OF LOAD CASE 4
5
SOIL LOADS
1
1 161797.5 0. 0. 0
7 • • • •
2 323595. • • •
6 • • • •
3 210336.8 • • •
5 • • • •
4 97078.5 • • •
8 492480. -226102.5 • •
14 • • • •
9 984960. -452205. • •
13 • • • •
10 640224. -293933.3 • •
12 • • • •
11 295488. -135661.5 • •
15 304762.5 -200502.3 • •
21 • • • •
16 609525. -401004.6 • •
20 • • • •
17 396191.3 -260653. • •
19 • • • •
18 182857.5 -120301.4 • •
22 80257.5 -52803.9 • •
28 • • • •
23 160515. -105607.8 • •
27 • • • •
24 104334.8 -68645.1 • •
26 • • • •
25 48154.5 -31682.3 • •
57 37186.9 -15586.9 • •
63 • • • •
58 74373.8 -31173.9 • •
62 • • • •
59 48342.9 -20263. • •
61 • • • •
60 22312.1 -9352.2 • •
64 14200.3 -6075. • •
70 • • • •
65 28400.6 -12150. • •
69 • • • •
66 18460.4 -7897.5 • •
68 • • • •
67 8520.2 -3645. • •
71 1620. -2025. • •
77 • • • •
72 3240. -4050. • •
76 • • • •
73 2106. -2632.5 • •
75 • • • •
336 972. -1215. • •
END OF LTYPE 1
END OF LOAD CASE 5
END OF LOADS
$LCOMB
11
LOAD COMBINATION 11
1 1 2 1 3 1 4 1 5 1
END OF LOAD COMB 11
END OF LOAD COMB DEF
$LOVE
$ARRAY
$STIFF
$STATIC
$SOLVE
$DISP
$STRESS
0
ALL
ALL
$ENDP
$
```

Figure H3. (Sheet 6 of 6)

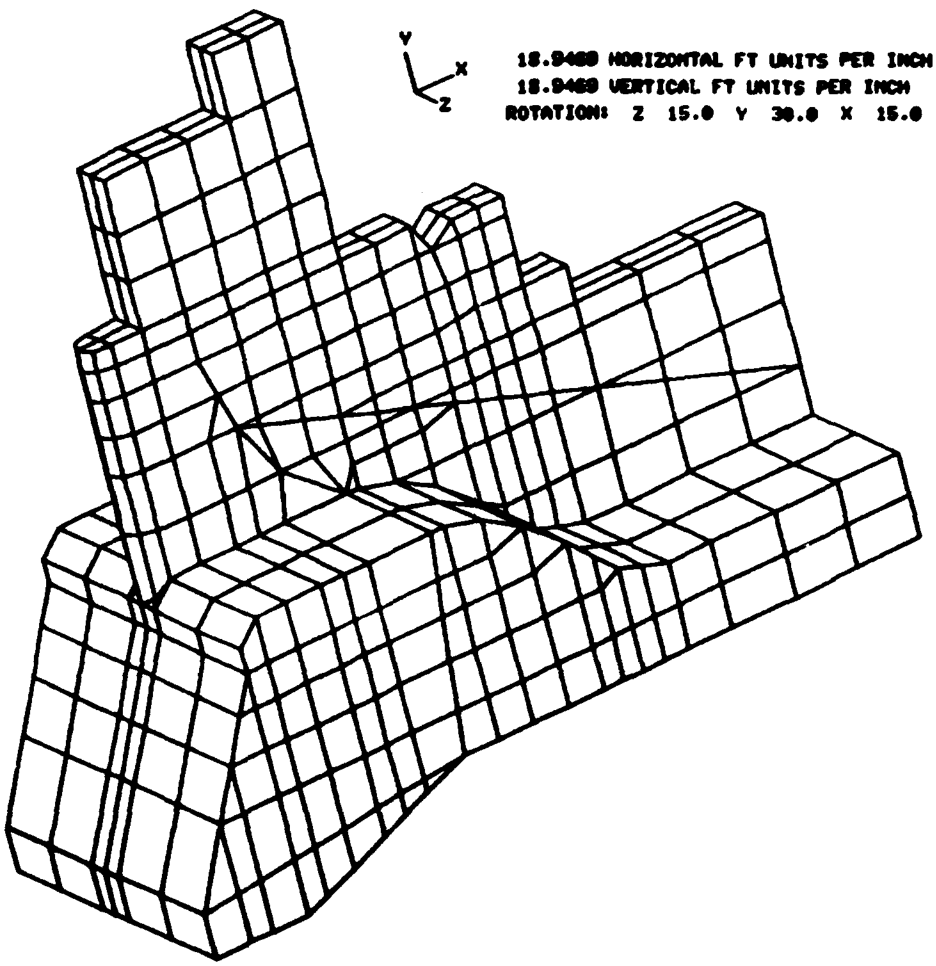

Figure H4. GTSTRUDL 3-D study geometry plot

```
STRUDL ' L&D3  INTERMEDIATE PIER '
UNITS KIP FEET
 TYPE TRIDIMENSIONAL
$ $$$$$$$$$$$$$$$$$$$$$$$$$$$$$  GEOMETRY DEFINITION  $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
JOINT COORDINATES
$ WEIR NODES FOR GENERATE BETWEEN COMMANDS $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
1 0. 0. 0. ; 625 0. 0. 69.
4 20. 0. 0. ; 628 20. 0. 69.
10 0. 8.5 0. ;634 0. 8.5 69.
19 57.5 15. 0. ; 643 57.5 15. 69.
31 154. 15. 0. ; 655 154. 15. 69.
32 7.632 23. 0. ; 656 7.632 23. 69.
52 154. 23. 0. ; 676 154. 23. 69.
53 12.368 32. 0. ; 677 12.368 32. 69.
65 91.36 32. 0. ; 689 91.36 32. 69.
66 95.72 33.78 0. ; 690 95.72 33.78 69.
67 100.416 32.475 0. ; 691 100.416 32.475 69.
68 105.5 31. 0. ; 692 105.5 31. 69.
72 154. 31. 0. ; 696 154. 31. 69.
73 16.579 40. 0. ; 697 16.579 40. 69.
83 79.5 40. 0. ; 707 79.5 40. 69.
84 87. 42.5 0. ; 708 87. 42.5 69.
85 91.36 38.14 0. ; 709 91.36 38.14 69.
86 20. 46.5 0. ; 710 20. 46.5 69.
94 72. 46.5 0. ; 718 72. 46.5 69.
95 79.5 48.875 0. ; 719 79.5 48.875 69.
96 20. 51. 0. ; 720 20. 51. 69.
97 24.5 55. 0. ; 721 24.5 55. 69.
102 62. 55. 0. ; 726 62. 55. 69.
103 64.75 54.849 0. ; 727 64.75 54.849 69.
104 72. 53. 0. ; 728 72. 53. 69.
$ PIER NOSING NODES FOR GENERATE BETWEEN COMMANDS $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
729 21.318 .527 37.682 ; 741 21.318 99. 37.682
742 21.318 .527 31.318 ; 754 21.318 99. 31.318
755 20. 64. 34.5 ; 760 20. 99. 34.5
$ PIER NODES FOR GENERATE BETWEEN COMMANDS $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
761 57.5 140. 30. ; 904 57.5 140. 34.5 ; 1047 57.5 140. 39.
762 64.75 140. 30. ; 905 64.75 140. 34.5 ; 1048 64.75 140. 39.
763 72. 140. 30. ; 906 72. 140. 34.5 ; 1049 72. 140. 39.
764 31. 127.42 30. ; 1050 31. 127.42 39.
769 72. 127.42 30. ; 1055 72. 127.42 39.
799 72. 89.316 30. ; 1085 72. 89.316 39.
794 31. 89.316 30. ; 1080 31. 89.316 39.
800 24.5 99. 30. ; 943 24.5 99. 34.5 ; 1086 24.5 99. 39.
805 24.5 64. 30. ; 948 24.5 64. 34.5 ; 1091 24.5 64. 39.
806 79.5 95. 30. ; 949 79.5 95. 34.5 ; 1092 79.5 95. 39.
807 86.896 95. 30. ; 950 86.896 95. 34.5 ; 1093 86.896 95. 39.
808 79.5 89.316 30. ; 951 79.5 89.316 34.5 ; 1094 79.5 89.316 39.
809 87. 89.316 30. ; 952 87. 89.316 34.5 ; 1095 87. 89.316 39.
810 90.024 89.316 30. ; 953 90.024 89.316 34.5 ; 1096 90.024 89.316 39.
811 31. 82.158 30. ; 954 31. 82.158 34.5 ; 1097 31. 82.158 39.
819 91.36 82.158 30. ; 962 91.36 82.158 34.5 ; 1105 91.36 82.158 39.
820 31. 75. 30. ; 963 31. 75. 34.5 ; 1106 31. 75. 39.
828 86.896 75. 30. ; 971 86.896 75. 34.5 ; 1114 86.896 75. 39.
829 91.36 75.5 30. ; 972 91.36 75.5 34.5 ; 1115 91.36 75.5 39.
843 72. 69. 30. ; 986 72. 69. 34.5 ; 1129 72. 69. 39.
846 91.36 69. 30. ; 989 91.36 69. 34.5 ; 1132 91.36 69. 39.
855 91.36 64. 30. ; 998 91.36 64. 34.5 ; 1141 91.36 64. 39.
856 64.75 59.5 30. ; 999 64.75 59.5 34.5 ; 1142 64.75 59.5 39.
857 72. 59.5 30. ; 1000 72. 59.5 34.5 ; 1143 72. 59.5 39.
858 79.5 59.5 30. ; 1001 79.5 59.5 34.5 ; 1144 79.5 59.5 39.
859 79.5 52.815 30. ; 1002 79.5 52.815 34.5 ; 1145 79.5 52.815 39.
860 87. 52.815 30. ; 1003 87. 52.815 34.5 ; 1146 87. 52.815 39.
861 91.36 52.815 30. ; 1004 91.36 52.815 34.5 ; 1147 91.36 52.815 39.
862 91.36 40.33 30. ; 1005 91.36 40.33 34.5 ; 1148 91.36 40.33 39.
863 95.72 76. 30. ; 1149 95.72 76. 39.
865 105.5 76. 30. ; 1151 105.5 76. 39.
869 95.72 89.316 30. ; 1155 95.72 89.316 39.
871 105.5 89.316 30. ; 1157 105.5 89.316 39.
872 95.167 92.83 30. ; 1015 95.167 92.83 34.5 ; 1158 95.167 92.83 39.
873 100.416 92.83 30. ; 1016 100.416 92.83 34.5 ; 1159 100.416 92.83 39.
874 105.5 92.83 30. ; 1017 105.5 92.83 34.5 ; 1160 105.5 92.83 39.
875 114.5 76. 30. ; 1018 114.5 76. 34.5 ; 1161 114.5 76. 39.
876 95.72 40.33 30. ; 1162 95.72 40.33 39.
882 154. 40.33 30. ; 1168 154. 40.33 39.
897  95.72 69. 30. ; 1183 95.72 69. 39.
903 154. 69. 30. ; 1189 154. 69. 39.
$ WEIR NODE GENERATION $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
GEN B 1 625 ID 105 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
GEN B 4 628 ID 108 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
GEN B 10 634 ID 114 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
GEN B 19 643 ID 123 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
GEN B 31 655 ID 135 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
MODIFY 1 JOINT INC 1 ID INC 1
GEN B 52 676 ID 156 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
```

Figure H5. GTSTRUDL 3-D study data file (Sheet 1 of 6)

```
MODIFY 1 JOINT INC 1 ID INC 1
GEN B 65 689 ID 169 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
MODIFY 3 JOINT INC 1 ID INC 1
GEN B 72 696 ID 176 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
MODIFY 1 JOINT INC 1 ID INC 1
GEN B 83 707 ID 187 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
MODIFY 3 JOINT INC 1 ID INC 1
GEN B 94 718 ID 198 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
MODIFY 3 JOINT INC 1 ID INC 1
GEN B 102 726 ID 206 INC 104
XD 6 PARTS ARB 15. 15. 4.5 4.5 15. 15.
MODIFY 2 JOINT INC 1 ID INC 1
GEN B 1 4
XD 3 PARTS ARB 7.632 4.736 7.632
MODIFY 6 JOINT INC 104 ID INC 104
GEN B 4 10 ID 5 INC 1
XD 6 PARTS ARB 4.5 6.5 7.5 5. 5.25 8.75
MODIFY 6 JOINT INC 104 ID INC 104
GEN B 10 18
XD 9 PARTS ARB 7.632 4.736 7.632 4.5 6.5 7.5 5. 5.25 8.75
MODIFY 6 JOINT INC 104 ID INC 104
GEN B 19 31
XD 12 PARTS ARB 7.25 7.25 7.5 7.5 4.36 4.36 4.696 5.084 9. 13.5 13. 13.
MODIFY 6 JOINT INC 104 ID INC 104
GEN B 32 52
XD 20 PARTS ARB 4.736 7.636 4.5 6.5 7.5 5. 5.25 9.65 6.35 7.25 7.5 7.5 -
    4.36 4.36 4.696 5.084 9. 13.5 13. 13.
MODIFY 6 JOINT INC 104 ID INC 104
GEN B 68 72
XD 4 PARTS ARB 9. 13.5 13. 13.
MODIFY 6 JOINT INC 104 ID INC 104
GEN B 53 65
XD 12 PARTS ARB 7.632 4.5 6.5 7.5 5. 5.25 10.662 5.338 7.25 7.5 7.5 4.36
MODIFY 6 JOINT INC 104 ID INC 104
GEN B 73 83
XD 10 PARTS ARB 3.421 4.5 6.5 7.5 5. 5.25 11.562 4.438 7.25 7.5
MODIFY 6 JOINT INC 104 ID INC 104
GEN B 86 94
XD 8 PARTS ARB 4.5 6.5 7.5 5. 5.25 12.294 3.706 7.25
MODIFY 6 JOINT INC 104 ID INC 104
GEN B 97 102
XD 5 PARTS ARB 6.5 7.5 5. 5.25 13.25
MODIFY 6 JOINT INC 104 ID INC 104
$ PIER NOSING NODE GENERATION $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
GEN B 729 741
XD 12 PARTS ARB 10.383 12.09 9. 8. 6.5 5.672 11.828 11. 7.158 7.158 5.684 4.
MODIFY 1 JOINT INC 13 ID INC 13
GEN B 755 760
XD 5 PARTS ARB 11. 7.158 7.158 5.684 4.
$ PIER NODE GENERATION $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
GEN B 794 799 769 764 1080 1085 1055 1050
XD 5 PARTS ARB 9. 8.75 8.75 7.25 7.25
YD 5 PARTS ARB 5.684 4. 9. 9. 10.42
ZD 2 PARTS EQUAL
GEN B 800 805
XD 5 PARTS ARB 4. 5.684 7.158 7.158 11.
MODIFY 2 JOINT INC 143 ID INC 143
GEN B 811 819
XD 8 PARTS ARB 11.198 6.552 8.75 7.25 7.25 7.5 7.5 4.36
MODIFY 2 JOINT INC 143 ID INC 143
GEN B 820 828
XD 8 PARTS ARB 7.5 5.812 4.438 8.75 7.25 7.25 7.5 7.5
MODIFY 2 JOINT INC 143 ID INC 143
 GEN B 843 846
XD 3 PARTS ARB 7.5 7.5 4.36
MODIFY 2 JOINT INC 143 ID INC 143
GEN B 805 855 ID 847 INC 1
XD 9 PARTS ARB 6.5 7.5 5. 7.058 6.942 7.25 7.25 15. 4.36
MODIFY 2 JOINT INC 143 ID INC 143
GEN B 863 865 871 869 1149 1151 1157 1155
XD 2 PARTS ARB 4.696 5.084
YD 2 PARTS ARB 6.158 7.158
ZD 2 PARTS EQUAL
GEN B 876 882 903 897 1162 1168 1189 1183
XD 6 PARTS ARB 4.696 5.084 9. 13.5 13. 13.
YD 3 PARTS ARB 12.486 11.185 5.
ZD 2 PARTS EQUAL
GEN B 822 882 ID 830 INC 1
XD 13 PARTS ARB 4.438 8.75 7.25 7.25 7.113 7.887 4.36 4.36 4.696 5.084 -
    22.5 13. 13.
MODIFY 2 JOINT INC 143 ID INC 143
ELEMENT INCIDENCES
$    WEIR ELEMENT GENERATION $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
GEN 6 ELEMENTS ID 1,83 FROM 1,104 TO 10,104 TO 11,104 TO 2,104 -
  TO 105,104 TO 114,104 TO 115,104 TO 106,104
MODIFY 2 ID 1 FROM 1
GEN 4 ELEMENTS ID 5,1 FROM 5,1 TO 14,1 TO 15,1 TO 6,1 -
  TO 109,1 TO 118,1 TO 119,1 TO 110,1
```

Figure H5. (Sheet 2 of 6)

```
MODIFY 5 ID 83 FROM 104
GEN 6 ELEMENTS ID 9,83 FROM 9,104 TO 18,104 TO 19,104 -
  TO 113,104 TO 122,104 TO 123,104
MODIFY 1 ID 1 FROM 1 TO 14 TO -8 TO 1 TO 14 TO -8
GEN 2 ELEMENTS ID 11,1 FROM 11,1 TO 32,1 TO 33,1 TO 12,1 -
  TO 115,1 TO 136,1 TO 137,1 TO 116,1
MODIFY 5 ID 83 FROM 104
GEN 6 ELEMENTS ID 31,83 FROM 32,104 TO 53,104 TO 33,104 -
  TO 136,104 TO 157,104 TO 137,104
MODIFY 1 ID 33 FROM 41 TO 33 TO 41 TO 41 TO 33 TO 41
GEN 2 ELEMENTS ID 32,19 FROM 33,20 TO 53,20 TO 54,20 TO 34,20 -
  TO 137,20 TO 157,20 TO 158,20 TO 138,20
MODIFY 5 ID 83 FROM 104
GEN 17 ELEMENTS ID 14,1 FROM 14,1 TO 35,1 TO 36,1 TO 15,1 -
  TO 118,1 TO 139,1 TO 140,1 TO 119,1
MODIFY 1 ID 20 FROM 21 TO 20 TO 20 TO 21 TO 21 TO 20 TO 20 TO 21
MODIFY 5 ID 83 FROM 104
GEN 9 ELEMENTS ID 53,1 FROM 55,1 TO 75,1 TO 76,1 TO 56,1 -
  TO 159,1 TO 179,1 TO 180,1 TO 160,1
MODIFY 1 ID 13 FROM 20 TO 12 TO 12 TO 20 TO 20 TO 12 TO 12 TO 20
MODIFY 5 ID 83 FROM 104
GEN 2 ELEMENTS ID 61,1 FROM 63,1 TO 83,1 TO 84,1 TO 64,1 -
  TO 167,1 TO 187,1 TO 188,1 TO 168,1
MODIFY 5 ID 83 FROM 104
GEN 6 ELEMENTS ID 63,83 FROM 65,104 TO 85,104 TO 66,104 -
  TO 169,104 TO 189,104 TO 170,104
MODIFY 1 ID 11 FROM 18 TO 10 TO 18 TO 18 TO 10 TO 18
GEN 7 ELEMENTS ID 76,1 FROM 87,1 TO 97,1 TO 98,1 TO 88,1 -
  TO 191,1 TO 201,1 TO 202,1 TO 192,1
MODIFY 5 ID 83 FROM 104
GEN 6 ELEMENTS ID 83,83 FROM 94,104 TO 104,104 TO 95,104 -
  TO 198,104 TO 208,104 TO 199,104
GEN 2 ELEMENTS ID 4,9 FROM 4,9 TO 13,21 TO 14,21 TO 5,9 -
  TO 108,9 TO 117,21 TO 118,21 TO 109,9
MODIFY 1 ID 83 FROM 104
MODIFY 1 ID 332 FROM 416
GEN 2 ELEMENTS ID 33,19 FROM 34,20 TO 54,20 TO 55,20 TO 35,20 -
  TO 138,20 TO 158,20 TO 159,20 TO 139,20
MODIFY 1 ID 83 FROM 104
MODIFY 1 ID 332 FROM 416
GEN 2 ELEMENTS ID 65,10 FROM 74,12 TO 86,10 TO 87,10 TO 75,12 -
  TO 178,12 TO 190,10 TO 191,10 TO 179,12
MODIFY 1 ID 83 FROM 104
MODIFY 1 ID 332 FROM 416
$    PIER NOSING ELEMENTS $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
ELEMENT INCIDENCES
499 420 421 729 429 430 730 ; 500 429 430 730 450 451 731
501 450 451 731 470 471 732 ; 502 470 471 732 490 491 733
503 490 491 733 502 503 734 ; 504 502 503 734 512 513 735
505 316 420 729 325 429 730 ; 506 325 429 730 346 450 731
507 346 450 731 366 470 732 ; 508 366 470 732 386 490 733
509 386 490 733 398 502 734 ; 510 398 502 734 408 512 735
511 212 316 742 221 325 743 ; 512 221 325 743 242 346 744
513 242 346 744 262 366 745 ; 514 262 366 745 282 386 746
515 282 386 746 294 398 747 ; 516 294 398 747 304 408 748
517 212 742 213 221 743 222 ; 518 221 743 222 242 744 243
519 242 744 243 262 745 263 ; 520 262 745 263 282 746 283
521 282 746 283 294 747 295 ; 522 294 747 295 304 748 305
523 316 729 421 317 325 730 430 326 ; 524 325 730 430 326 346 731 451 347
525 346 731 451 347 366 732 471 367 ; 526 366 732 471 367 386 733 491 387
527 386 733 491 387 398 734 503 399 ; 528 398 734 503 399 408 735 513 409
529 408 735 513 409 755 736 1091 948 ; 541 408 409 305 748 755 948 805 749
535 316 317 213 742 325 326 222 743 ; 536 325 326 222 743 346 347 243 744
537 346 347 243 744 366 367 263 745 ; 538 366 367 263 745 386 387 283 746
539 386 387 283 746 398 399 295 747 ; 540 398 399 295 747 408 409 305 748
GEN 5 ELEMENTS ID 542,1 FROM 749,1 TO 755,1 TO 948,-1 TO 805,-1 -
  TO 750,1 TO 756,1 TO 947,-1 TO 804,-1
MODIFY 1 ID -12 FROM 6 TO -19 TO 143 TO 143 TO 6 TO -19 TO 143 TO 143
$       PIER ELEMENTS $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
GEN 2 ELEMENTS ID 547,2 FROM 767,1 TO 761,1 TO 762,1 TO 768,1 -
  TO 910,1 TO 904,1 TO 905,1 TO 911,1
MODIFY 1 ID 1 FROM 143
GEN 5 ELEMENTS ID 551,2 FROM 770,1 TO 764,1 TO 765,1 TO 771,1 -
  TO 913,1 TO 907,1 TO 908,1 TO 914,1
MODIFY 4 ID 10 FROM 6
MODIFY 1 ID 1 FROM 143
ELEMENT INCIDENCES
601 801 800 782 788 944 943 925 931 ; 602 944 943 925 931 1087 1086 1068 1074
603 802 801 788 794 945 944 931 937 ; 604 945 944 931 937 1088 1087 1074 1080
605 803 802 794 811 946 945 937 954 ; 606 946 945 937 954 1089 1088 1080 1097
607 804 803 811 820 947 946 954 963 ; 608 947 946 954 963 1090 1089 1097 1106
609 805 804 820 847 948 947 963 990 ; 610 948 947 963 990 1091 1090 1106 1133
611 305 805 847 306 409 948 990 410 ; 612 409 948 990 410 513 1091 1133 514
GEN 5 ELEMENTS ID 613,2 FROM 811,1 TO 794,1 TO 795,1 TO 812,1 -
  TO 954,1 TO 937,1 TO 938,1 TO 955,1
MODIFY 1 ID 1 FROM 143
ELEMENT INCIDENCES
623 799 793 806 808 942 936 949 951 ; 624 942 936 949 951 1085 1079 1092 1094
625 808 806 807 809 951 949 950 952 ; 626 951 949 950 952 1094 1092 1093 1095
627 809 807 810 952 950 953 ; 628 952 950 953 1095 1093 1096
629 810 872 869 953 1015 1012 ; 630 953 1015 1012 1096 1158 1155
```

Figure H5. (Sheet 3 of 6)

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631 816 799 808 817 959 942 951 960 ; 632 959 942 951 960 1102 1085 1094 1103
633 817 808 809 818 960 951 952 961 ; 634 960 951 952 961 1103 1094 1095 1104
635 818 809 810 819 961 952 953 962 ; 636 961 952 953 962 1104 1095 1096 1105
637 819 810 869 866 962 953 1012 1009 ; 638 962 953 1012 1009 1105 1096 1155 -
  1152
639 820 811 812 821 963 954 955 964 ; 640 963 954 955 964 1106 1097 1098 1107
641 821 812 822 964 955 965 ; 642 964 955 965 1107 1098 1108
GEN 7 ELEMENTS ID 643,2 FROM 822,1 TO 812,1 TO 813,1 TO 823,1 -
  TO 965,1 TO 955,1 TO 956,1 TO 966,1
MODIFY 1 ID 1 FROM 143
ELEMENT INCIDENCES
657 829 819 866 863 972 962 1009 1006
658 972 962 1009 1006 1115 1105 1152 1149
659 847 820 821 848 990 963 964 991 ; 660 990 963 964 991 1133 1106 1107 1134
661 848 821 822 849 991 964 965 992 ; 662 991 964 965 992 1134 1107 1108 1135
663 849 822 850 992 965 993 ; 664 992 965 993 1135 1108 1136
665 822 823 830 965 966 973 ; 666 965 966 973 1108 1109 1116
667 822 830 850 965 973 993 ; 668 965 973 993 1108 1116 1136
669 830 823 824 831 973 966 967 974 ; 670 973 966 967 974 1116 1109 1110 1117
671 850 830 831 851 993 973 974 994 ; 672 993 973 974 994 1136 1116 1117 1137
673 831 824 825 832 974 967 968 975 ; 674 974 967 968 975 1117 1110 1111 1118
675 851 831 832 852 994 974 975 995 ; 676 994 974 975 995 1137 1117 1118 1138
677 832 825 826 843 975 968 969 986 ; 678 975 968 969 986 1118 1111 1112 1129
679 832 843 833 975 986 976 ; 680 975 986 976 1118 1129 1119
681 852 832 833 853 995 975 976 996 ; 682 995 975 976 996 1138 1118 1119 1139
GEN 3 ELEMENTS ID 683,2 FROM 843,1 TO 826,1 TO 827,1 TO 844,1 -
  TO 986,1 TO 969,1 TO 970,1 TO 987,1
MODIFY 1 ID 1 FROM 143
ELEMENT INCIDENCES
689 846 829 863 897 989 972 1006 1040
690 989 972 1006 1040 1132 1115 1149 1183
691 833 843 844 834 976 986 987 977 ; 692 976 986 987 977 1119 1129 1130 1120
693 853 833 834 996 976 977 ; 694 996 976 977 1139 1119 1120
695 834 844 845 854 977 987 988 997 ; 696 977 987 988 997 1120 1130 1131 1140
697 854 845 846 855 997 988 989 998 ; 698 997 988 989 998 1140 1131 1132 1141
699 855 846 897 890 998 989 1040 1033 ; 700 998 989 1040 1033 1141 1132 1183 -
  1176
GEN 2 ELEMENTS ID 701,2 FROM 897,1 TO 863,1 TO 864,1 TO 898,1 -
  TO 1040,1 TO 1006,1 TO 1007,1 TO 1041,1
MODIFY 1 ID 1 FROM 143
ELEMENT INCIDENCES
705 899 865 875 900 1042 1008 1018 1043
706 1042 1008 1018 1043 1185 1151 1161 1186
GEN 2 ELEMENTS ID 707,2 FROM 863,1 TO 866,1 TO 867,1 TO 864,1 -
  TO 1006,1 TO 1009,1 TO 1010,1 TO 1007,1
MODIFY 2 ID 4 FROM 3
MODIFY 1 ID 1 FROM 143
GEN 3 ELEMENTS ID 719,2 FROM 306,1 TO 847,1 TO 848,1 TO 307,1 -
  TO 410,1 TO 990,1 TO 991,1 TO 411,1
MODIFY 1 ID 1 FROM 104 TO 143 TO 143 TO 104 TO 104 TO 143 TO 143 TO 104
ELEMENT INCIDENCES
725 309 850 310 413 993 414 ; 726 413 993 414 517 1136 518
727 850 851 310 993 994 414 ; 728 993 994 414 1136 1137 518
729 310 851 852 856 414 994 995 999 ; 730 414 994 995 999 518 1137 1138 1142
731 310 856 311 414 999 415 ; 732 414 999 415 518 1142 519
733 856 852 853 857 999 995 996 1000 ; 734 999 995 996 1000 1142 1138 1139 -
  1143
735 857 853 834 858 1000 996 977 1001 ; 736 1000 996 977 1001 1143 1139 1120 -
  1144
737 858 834 835 1001 977 978 ; 738 1001 977 978 1144 1120 1121
739 834 854 835 977 997 978 ; 740 977 997 978 1120 1140 1121
741 311 856 857 312 415 999 1000 416 ; 742 415 999 1000 416 519 1142 1143 520
743 312 857 858 859 416 1000 1001 1002 ; 744 416 1000 1001 1002 520 1143 -
  1144 1145
745 859 858 835 860 1002 1001 978 1003
746 1002 1001 978 1003 1145 1144 1121 1146
747 312 859 303 416 1002 407 ; 748 416 1002 407 520 1145 511
749 303 859 860 292 407 1002 1003 396
750 407 1002 1003 396 511 1145 1146 500
GEN 6 ELEMENTS ID 751,2 FROM 890,1 TO 897,1 TO 898,1 TO 891,1 -
  TO 1033,1 TO 1040,1 TO 1041,1 TO 1034,1
MODIFY 1 ID 1 FROM 143
ELEMENT INCIDENCES
763 835 854 855 836 978 997 998 979 ; 764 978 997 998 979 1121 1140 1141 1122
765 836 855 890 837 979 998 1033 980 ; 766 979 998 1033 980 1122 1141 1176 1123
767 837 890 891 838 980 1033 1034 981
768 980 1033 1034 981 1123 1176 1177 1124
769 838 891 892 839 981 1034 1035 982
770 981 1034 1035 982 1124 1177 1178 1125
771 860 835 836 861 1003 978 979 1004
772 1003 978 979 1004 1146 1121 1122 1147
773 861 836 837 883 1004 979 980 1026
774 1004 979 980 1026 1147 1122 1123 1169
775 883 837 838 884 1026 980 981 1027
776 1026 980 981 1027 1169 1123 1124 1170
777 884 838 839 885 1027 981 982 1028
778 1027 981 982 1028 1170 1124 1125 1171
779 839 892 893 886 982 1035 1036 1029
780 982 1035 1036 1029 1125 1178 1179 1172
781 885 839 886 1028 982 1029 ; 782 1028 982 1029 1171 1125 1172
GEN 3 ELEMENTS ID 783,2 FROM 886,1 TO 893,1 TO 894,1 TO 887,1 -
  TO 1029,1 TO 1036,1 TO 1037,1 TO 1030,1
```

Figure H5. (Sheet 4 of 6)

```
MODIFY 1 ID 1 FROM 143
ELEMENT INCIDENCES
789 292 860 861 862 396 1003 1004 1005
790 396 1003 1004 1005 500 1146 1147 1148
791 862 861 883 876 1005 1004 1026 1019
792 1005 1004 1026 1019 1148 1147 1169 1162
GEN 3 ELEMENTS ID 793,2 FROM 876,1 TO 883,1 TO 884,1 TO 877,1 -
  TO 1019,1 TO 1026,1 TO 1027,1 TO 1020,1
MODIFY 1 ID 1 FROM 143
ELEMENT INCIDENCES
799 879 886 840 880 1022 1029 983 1023
800 1022 1029 983 1023 1165 1172 1126 1166
801 886 887 840 1029 1030 983
802 1029 1030 983 1172 1173 1126
803 880 840 841 881 1023 983 984 1024
804 1023 983 984 1024 1166 1126 1127 1167
805 840 887 888 841 983 1030 1031 984
806 983 1030 1031 984 1126 1173 1174 1127
807 981 841 882 1024 984 1025 ; 808 1024 984 1025 1167 1127 1168
809 841 888 889 882 984 1031 1032 1025
810 984 1031 1032 1025 1127 1174 1175 1168
811 292 862 293 396 1005 397 ; 812 396 1005 397 500 1148 501
813 293 862 876 274 397 1005 1019 378
814 397 1005 1019 378 501 1148 1162 482
GEN 6 ELEMENTS ID 815,2 FROM 274,1 TO 876,1 TO 877,1 TO 275,1 -
  TO 378,1 TO 1019,1 TO 1020,1 TO 379,1
MODIFY 1 ID 1 FROM 104 TO 143 TO 143 TO 104 TO 104 TO 143 TO 143 TO 104
$
$ $$$$$$$$$$$$$$$$$$$$$$  END OF GEOMETRY DEFINITION $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$
$ $$$$$$$$$$$$$$$$$$$$$$$$$$$$   SUPPORTS   $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$
STATUS SUPPORTS 1 TO 104,625 TO 728,106 TO 113,123 TO 136,209 TO 217, -
    227 TO 239,313 TO 321,331 TO 343,417 TO 425,436 TO 447,521 TO 529, -
    539 TO 551,729,742
$
$ $$$$$$$$$$$$$$$$$$$$$$$$$$$$  JOINT RELEASES  $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$
JOINT RELEASES
10 TO 18,32 TO 104,634 TO 642 656 TO 728 FORCE X Y
1 TO 625 BY 104 FORCE X
$
$ $$$$$$$$$$$$$$$$$$$$$$$$$$$$  ELEMENT PROPERTIES  $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
ELEMENT PROPERTIES
9 TO 424 BY 83,10 TO 425 BY 83,31 TO 446 BY 83,63 TO 478 BY 83,64 TO 479 -
 BY 83,74 TO 489 BY 83,83 TO 498 BY 83,499 TO 522,627 TO 630,641,642,663 -
 TO 668,679,680,693,694,725 TO 728,731,732,737 TO 740,747,748,781,782,801, -
 802,807,808,811,812 TYPE 'TRIP'
ELEMENT PROPERTIES
1 TO 8,11 TO 30,32 TO 62,65 TO 73,75 TO 82,84 TO 91,94 TO 113,115 TO 145, -
 148 TO 156,158 TO 165,167 TO 169,171 TO 174,177,178,180 TO 196,198,200 TO -
 217,219 TO 228,232 TO 239,242 TO 248,250 TO 252,254 TO 257,260,261,263 TO -
 279,281,283 TO 300,302 TO 311,315 TO 322,325 TO 331 TYPE 'IPLS'
ELEMENT PROPERTIES
333 TO 340,343 TO 362,364 TO 394,397 TO 405,407 TO 414,416 TO 423,426 TO 445, -
 447 TO 477,480 TO 488,490 TO 497,523 TO 626,631 TO 640,643 TO 662,669 TO 678, -
 681 TO 692,695 TO 724,729,730,733 TO 736,741 TO 746,749 TO 780,783 TO 800, -
 803 TO 806,809,810,813 TO 826 TYPE 'IPLS'
$
$
UNITS INCHES POUNDS
$ $$$$$$$$$$$$$$$$$$$$$$$$$$$$  CONSTANTS  $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$
CONSTANTS
E 3122000. ALL BUT 1075216.8 MEM 547 TO 550,557 TO 560,567 TO 570 -
    577 TO 580,587 TO 590
POI .17 ALL
UNITS FEET
$ $$$$$$$$$$$$$$$$$$$$$$$$$$$$  LOADING  $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
LOADING 1 'MACHINE HOUSE,SERVICE BRIDGE,TAINTER GATE LOADS'
JOINT LOADS
$ -------------- MACHINE HOUSE ------------------------------------------------
786 908 1052 910 FOR Y -48187.5
909 FOR Y -96375.0
765 767 1051 1053 FOR Y -24093.75
$
$ -------------- SERVICE BRIDGE -----------------------------------------------
764 765 1051 1050 FOR Y -33000.
$
$ -------------- TAINTER GATE -------------------------------------------------
$        1/2 OPEN SIDE
766 FOR X -27000. Y -112000.
809 FOR X 445000. Y 153000.
$        CLOSED SIDE
1095 FOR X 1575000. Y 1034000.
518 726 FOR Y -41500.
622 FOR Y -83000.
$                    TRUNION GIRDER DEAD WEIGHT
1096 210 FOR Y -55200.
953 FOR Y -43200.
$
$ ---------------- END OF LOADING 1 ---------------------------------------------
```

Figure H5. (Sheet 5 of 6)

```
$
LOADING 2 'SOIL LOADS'
JOINT LOADS
1 625 FOR X 161797.5
10 634 FORCE X 378600. Y -147849.9
32 656 FORCE X 288352.5 Y -185751.9
53 677 FORCE X 148290. Y -93600.
73 697 FORCE X 80257.5 Y -52803.9
86 710 FORCE X 37186.9 Y -15586.9
96 720 FORCE X 14200.3 Y -6075.
97 721 FORCE X 1620. Y -2025.
105 521 FORCE X 323595.
114 530 FORCE X 745200. Y -294490.8
136 552 FORCE X 564705. Y -371503.8
157 573 FORCE X 284580. Y -187216.
177 593 FORCE X 160515. Y -105607.8
190 606 FORCE X 74373.8 Y -31173.9
200 616 FORCE X 28400.6 Y -12150.
201 617 FORCE X 3240. Y -4050.
209 417 FORCE X 210336.8
218 426 FORCE X 484380. Y -191424.9
240 448 FORCE X 367058.3 Y -241477.5
261 469 FORCE X 184977. Y -121690.4
281 489 FORCE X 104334.8 Y -68645.1
294 502 FORCE X 48342.9 Y -20263.
304 512 FORCE X 18460.4 Y -7897.5
305 513 FORCE X 2106. Y -2638.5
313 FORCE X 97078.5
322 FORCE X 223560. Y -88349.94
344 FORCE X 169411.5 Y -111451.1
365 FORCE X 85374. Y -56164.8
385 FORCE X 48154.5 Y -31682.3
398 FORCE X 22312.1 Y -9352.2
408 FORCE X 9492.2
748 FORCE Y -2430.
735 FORCE Y -2430.
$
$ -------------------- END OF LOADING 2 ----------------------------------
$
LOADING 3 'HYDROSTATIC LOADS'
JOINT LOADS
$                U/S WEIR FACE
735 748 FORCE X 23625. Y -26578.1
$            PIER SURFACE OF GATE 1/2 OPEN SIDE ( Z=30 PLANE )
812 821 822 FORCE Z 7618.7
822 850 830 FORCE Z 1253.4
849 850 822 FORCE Z 5396.3
309 310 850 FORCE Z 17397.9
850 851 310 FORCE Z 6563.
856 310 311 FORCE Z 1649.2
858 834 835 FORCE Z 523.6
312 859 303 FORCE Z 4032.6
885 839 886 FORCE Z 252.9
853 833 834 FORCE Z 124.5
292 293 862 FORCE Z 2015.6
841 881 882 FORCE Z 762.1
$               PIER SURFACE OF GATE CLOSED SIDE ( Z=39 PLANE )
1098 1107 1108 FORCE Z -7618.7
1108 1135 1136 FORCE Z -22105.3
511 520 1145 FORCE Z -3828.2
517 518 1136 FORCE Z -7453.1
518 1137 1136 FORCE Z -1952.4
518 519 1142 FORCE Z -1006.
1120 1121 1144 FORCE Z -837.6
1120 1121 1140 FORCE Z -170.8
1171 1125 1172 FORCE Z -2730.5
1126 1172 1173 FORCE Z -7533.2
1167 1168 1127 FORCE Z -12408.8
501 500 1148 FORCE Z -2355.0
ELEMENT LOADS
$                U/S WEIR FACE
1 TO 416 BY 83 SURF FOR FACE 3 VARI VZ -5937.5 -5937.5 -5406.3 -5406.3
10 TO 425 BY 83 SURF FOR FACE 1 VARI VZ -5406.3 -5406.3 -4500. -4500.
31 TO 446 BY 83 SURF FOR FACE 1 VARI VZ -4500. -4500. -3937.5 -3937.5
51 TO 466 BY 83 SURF FOR FACE 3 VARI VZ -3937.5 -3937.5 -3437.5 -3437.5
64 TO 479 BY 83 SURF FOR FACE 1 VARI VZ -3437.5 -3437.5 -3031.3 -3031.3
75 158 407 490 SURF FOR FACE 3 VARI VZ -3031.3 -3031.3 -2750. -2750.
75 158 407 490 SURF FOR FACE 4 VARI VZ -2750. -2750. -2500. -2500.
510 516 SURF FOR FACE 1 VARI VZ -2750. -2500. -2500. -2750.
$           WEIR SURFACE ON GATE 1/2 OPEN SIDE
76 TO 78,159 TO 161 SURF FOR FACE 4 GLOBAL PY -2500.
79 162 SURF FOR FACE 4 VARI VZ -1250. -1250. -1162.3 -1162.3
80 163 SURF FOR FACE 4 VARI VZ -1162.3 -1162.3 -900.2 -900.2
81 164 SURF FOR FACE 4 VARI VZ -900.2 -900.2 -855.7 -855.7
82 165 SURF FOR FACE 4 VARI VZ -855.7 -855.7 -828. -828.
83 166 SURF FOR FACE 2 VARI VZ -828. -828. -937.3 -937.3
74 157 SURF FOR FACE 2 VARI VZ -937.3 -937.3 -1187.9 -1187.9
62 145 SURF FOR FACE 4 VARI VZ -1187.9 -1187.9 -1374.3 -1374.3
63 146 SURF FOR FACE 2 VARI VZ -1374.3 -1374.3 -1560.7 -1560.7
45 128 SURF FOR FACE 4 VARI VZ -1560.7 -1560.7 -1549.5 -1549.5
46 129 SURF FOR FACE 4 VARI VZ -1549.5 -1549.5 -1541.3 -1541.3
47 130 SURF FOR FACE 4 VARI VZ -1541.3 -1541.3 -1363.4 -1363.4
48 131 SURF FOR FACE 4 VARI VZ -1363.4 -1363.4 -1096.8 -1096.8
```

Figure H5. (Sheet 6 of 6)

```
49 132 SURF FOR FACE 4 VARI VZ -1096.8 -1096.8 -830.9 -830.9
50 133 SURF FOR FACE 4 VARI VZ -830.9 -830.9 -583.1 -583.1
$                   PIER SURFACE GATE 1/2 OPEN SIDE
541 SURF FOR FACE 6 VARI VZ -2750. -2676.8 -1937.5 -1937.5
541 SURF FOR FACE 5 VARI VZ -2500. -1937.5 -1937.5 -2676.8
542 SURF FOR FACE 6 VARI VZ -1937.5 -1937.5 -1250. -1250.
542 SURF FOR FACE 3 VARI VZ -1937.5 -1250. -1250. -1937.5
543 SURF FOR FACE 6 VARI VZ -1250. -1250. -802.6 -802.6
543 SURF FOR FACE 3 VARI VZ -1250. -802.6 -802.6 -1250.
544 SURF FOR FACE 6 VARI VZ -802.6 -802.6 -355.3 -355.3
544 SURF FOR FACE 3 VARI VZ -802.6 -355.3 -355.3 -802.6
545 SURF FOR FACE 6 VARI VZ -355.3 -355.3 0. 0.
545 SURF FOR FACE 3 VARI VZ -355.3 0. 0. -355.3
603 591 SURF FOR FACE 1 VARI VZ -355.3 0. 0. -355.3
605 613 SURF FOR FACE 1 VARI VZ -802.6 -355.3 -355.3 -802.6
607 639 SURF FOR FACE 1 VARI VZ -1250. -802.6 -802.6 -1250.
609 659 661 SURF FOR FACE 1 VARI VZ -1937.5 -1250. -1250. -1937.5
611 719 721 SURF FOR FACE 1 VARI VZ -2500. -1937.5 -1937.5 -2500.
671 SURF FOR FACE 1 VARI VZ -563.6 0. 0. -427.
675 SURF FOR FACE 1 VARI VZ -427. 0. 0. -283.8
681 SURF FOR FACE 1 VARI VZ -283.8 0. 0. -140.5
723 SURF FOR FACE 1 VARI VZ -1250. -887.5 -563.6 -1162.3
729 SURF FOR FACE 1 VARI VZ -900.2 -427. -283.8 -565.
733 SURF FOR FACE 1 VARI VZ -565. -283.8 -140.5 -421.8
735 SURF FOR FACE 1 VARI VZ -421.8 -140.5 0. -273.3
741 SURF FOR FACE 1 VARI VZ -855.7 -565. -421.8 -828.
743 SURF FOR FACE 1 VARI VZ -828. -421.8 -273.3 -691.1
745 SURF FOR FACE 1 VARI VZ -691.1 -273.3 0. -543.3
771 SURF FOR FACE 1 VARI VZ -543.3 0. 0. -457.1
773 SURF FOR FACE 1 VARI VZ -457.1 0. 0. -371.
775 SURF FOR FACE 1 VARI VZ -371. 0. 0. -278.3
777 SURF FOR FACE 1 VARI VZ -278.3 0. 0. -177.8
749 SURF FOR FACE 1 VARI VZ -937.3 -691.1 -543.3 -1187.9
739 SURF FOR FACE 1 VARI VZ -1187.9 -543.3 -457.1 -1237.4
791 SURF FOR FACE 1 VARI VZ -1237.4 -457.1 -371. -1151.3
793 SURF FOR FACE 1 VARI VZ -1151.3 -371. -278.3 -1058.6
795 SURF FOR FACE 1 VARI VZ -1058.6 -278.3 -177.8 -958.1
797 SURF FOR FACE 1 VARI VZ -958.1 -177.8 0. -780.3
799 SURF FOR FACE 1 VARI VZ -780.3 0. 0. -513.6
803 SURF FOR FACE 1 VARI VZ -513.6 0. 0. -256.8
813 SURF FOR FACE 1 VARI VZ -1374.3 -1237.4 -1151.3 -1560.7
815 SURF FOR FACE 1 VARI VZ -1560.7 -1151.3 -1058.6 -1549.5
817 SURF FOR FACE 1 VARI VZ -1549.5 -1058.6 -958.1 -1541.3
819 SURF FOR FACE 1 VARI VZ -1541.3 -958.1 -780.3 -1363.4
821 SURF FOR FACE 1 VARI VZ -1363.4 -780.3 -513.6 -1096.8
823 SURF FOR FACE 1 VARI VZ -1096.8 -513.6 -256.8 -830.9
825 SURF FOR FACE 1 VARI VZ -830.9 -256.8 0. -583.1
$                   WEIR SURFACE GATE CLOSED SIDE
408 TO 411,491 TO 494 SURF FOR FACE 4 GLOBAL PY -2500.
412 495 SURF FOR FACE 4 GLOBAL PY -562.5
413 496 SURF FOR FACE 4 VARI VZ -562.5 -562.5 -571.9 -571.9
414 497 SURF FOR FACE 4 VARI VZ -571.9 -571.9 -687.5 -687.5
415 498 SURF FOR FACE 2 VARI VZ -687.5 -687.5 -945.3 -945.3
406 489 SURF FOR FACE 2 VARI VZ -945.3 -945.3 -1343.8 -1343.8
394 477 SURF FOR FACE 4 VARI VZ -1343.8 -1343.8 -1616.3 -1616.3
395 478 SURF FOR FACE 2 VARI VZ -1616.3 -1616.3 -1888.8 -1888.8
377 460 SURF FOR FACE 4 VARI VZ -1888.8 -1888.8 -1970.3 -1970.3
378 461 SURF FOR FACE 4 VARI VZ -1970.3 -1970.3 -2062.5 -2062.5
379 TO 382,462 TO 465 SURF FOR FACE 4 GLOBAL PY -2062.5
$                   PIER SURFACE GATE CLOSED SIDE
529 SURF FOR FACE 3 VARI VZ -2750. -1937.5 -1937.5 -2676.8
529 SURF FOR FACE 4 VARI VZ -2676.8 -1937.5 -1937.5 -2500.
530 SURF FOR FACE 3 VARI VZ -1937.5 -1250. -1250. -1937.5
530 SURF FOR FACE 4 VARI VZ -1937.5 -1250. -1250. -1937.5
531 SURF FOR FACE 3 VARI VZ -1250. -802.6 -802.6 -1250.
531 SURF FOR FACE 4 VARI VZ -1250. -802.6 -802.6 -1250.
532 SURF FOR FACE 3 VARI VZ -802.6 -355.3 -355.3 -802.6
532 SURF FOR FACE 4 VARI VZ -802.6 -355.3 -355.3 -802.6
533 SURF FOR FACE 3 VARI VZ -355.3 0. 0. -355.3
533 SURF FOR FACE 4 VARI VZ -355.3 0. 0. -355.3
604 592 SURF FOR FACE 2 VARI VZ -355.3 -355.3 0. 0.
606 614 SURF FOR FACE 2 VARI VZ -802.6 -802.6 -355.3 -355.3
608 640 SURF FOR FACE 2 VARI VZ -1250. -1250. -802.6 -802.6
610 660 662 SURF FOR FACE 2 VARI VZ -1937.5 -1937.5 -1250. -1250.
612 720 722 724 SURF FOR FACE 2 VARI VZ -2500. -2500. -1937.5 -1937.5
730 SURF FOR FACE 2 VARI VZ -562.5 -281.3 0. 0.
734 736 SURF FOR FACE 2 VARI VZ -281.3 -281.3 0. 0.
742 SURF FOR FACE 2 VARI VZ -571.9 -687.5 -281.3 -281.3
744 SURF FOR FACE 2 VARI VZ -687.5 -699.1 -281.3 -281.3
746 SURF FOR FACE 2 VARI VZ -699.1 -699.1 -155.8 -281.3
764 SURF FOR FACE 2 VARI VZ -155.8 -241.9 0. 0.
766 SURF FOR FACE 2 VARI VZ -241.9 -328.1 0. 0.
768 SURF FOR FACE 2 VARI VZ -328.1 -420.8 0. 0.
770 SURF FOR FACE 2 VARI VZ -420.8 -521.3 0. 0.
772 SURF FOR FACE 2 VARI VZ -699.1 -699.1 -241.9 -155.8
774 SURF FOR FACE 2 VARI VZ -699.1 -699.1 -328.1 -241.9
776 SURF FOR FACE 2 VARI VZ -699.1 -699.1 -420.8 -328.1
778 SURF FOR FACE 2 VARI VZ -699.1 -699.1 -521.3 -420.8
780 SURF FOR FACE 2 VARI VZ -521.3 -699.1 0. 0.
784 786 788 SURF FOR FACE 2 VARI VZ -699.1 -699.1 0. 0.
750 SURF FOR FACE 2 VARI VZ -945.3 -1343.8 -699.1 -699.1
790 SURF FOR FACE 2 VARI VZ -1343.8 -1479.4 -699.1 -699.1
```

```
792 TO 798 BY 2 SURF FOR FACE 2 VARI VZ -1479.4 -1479.4 -699.1 -699.1
800 SURF FOR FACE 2 VARI VZ -1479.4 -1479.4 -965.8 -699.1
804 SURF FOR FACE 2 VARI VZ -1479.4 -1479.4 -1222.6 -965.8
806 SURF FOR FACE 2 VARI VZ -965.8 -1222.6 -699.1 -699.1
810 SURF FOR FACE 2 VARI VZ -1222.6 -1479.4 -699.1 -699.1
814 SURF FOR FACE 2 VARI VZ -1616.3 -1888.8 -1479.4 -1479.4
816 SURF FOR FACE 2 VARI VZ -1888.8 -1970.3 -1479.4 -1479.4
818 SURF FOR FACE 2 VARI VZ -1970.3 -2062.5 -1479.4 -1479.4
820 TO 826 BY 2 SURF FOR FACE 2 VARI VZ -2062.5 -2062.5 -1479.4 -1479.4
$                  D/S PIER WALL FACE
798 SURF FOR FACE 5 VARI VZ 0. 0. 0. -699.1
810 SURF FOR FACE 5 VARI VZ -699.1 0. -780.3 -1479.4
809 SURF FOR FACE 5 VARI VZ 0. 0. 0. -780.3
826 SURF FOR FACE 5 VARI VZ -1479.4 -780.3 -1363.4 -2062.5
825 SURF FOR FACE 5 VARI VZ -780.3 0. -583.1 -1363.4
$
$ ---------------------- END OF LOADING 3 ---------------------------------
$
LOADING 4 ' DEAD LOAD '
ELEMENT LOADS
1 TO 546,551 TO 556,561 TO 566,571 TO 576,581 TO 586,591 TO 826 BODY FORCE -
    GLOBAL BY -150.
547 TO 550,557 TO 560,567 TO 570,577 TO 580,587 TO 590 BOD FOR GLO BY -51.66
$
$ -------------------- END OF LOADING 4 -----------------------------------
$
INACTIVE ELEMENT 55 138 221 304 387 470 170 179 199 218 231 241 253 262 -
                 282 301 314 324
STIFFNESS ANALYSIS
LOADING COMBINATION 5 'COMBINE ALL LOAD CASES'
COMBINE 5 1 1 2 1 3 1 4 1
UNITS KIPS FEET
OUTPUT ORDERED
LIST SUM REACTIONS ALL
LOAD LIST 5
UNITS POUNDS
LIST DISPLACEMENTS,STRESSES,PRINCIPAL STRESSES ALL
CALCULATE AVERAGE STRESS ALL
FINISH
```

APPENDIX I: NOTATION

NOTATION

a,b,h	Plate dimensions
A and B	Points of recorded displacement
e	Relative error in energy
E	Modulus of elasticity
H-version	Finite element code with accuracy dependent on the size of elements
K	Horizontal factor
L	Plate problems with varying span
N	Degrees of freedom
P-levels	Order of P-version element
P-version	Finite element code with accuracy dependent on the assumed order of elements
q	Uniform pressure
t	Thickness ratio
U	Potential energy for a particular P-level
U_o	Potential energy for infinite degrees of freedom
X, Y, Z	Coordinate axes
α	Singularity parameter (0.5 to 1)
δ	Displacement
ν	Poisson's ratio
γ	Unit weight
1	Solution from lower P-level
2	Solution from higher P-level

END
7-87
DTIC